MECHANICAL ENGINEERING

June 1957

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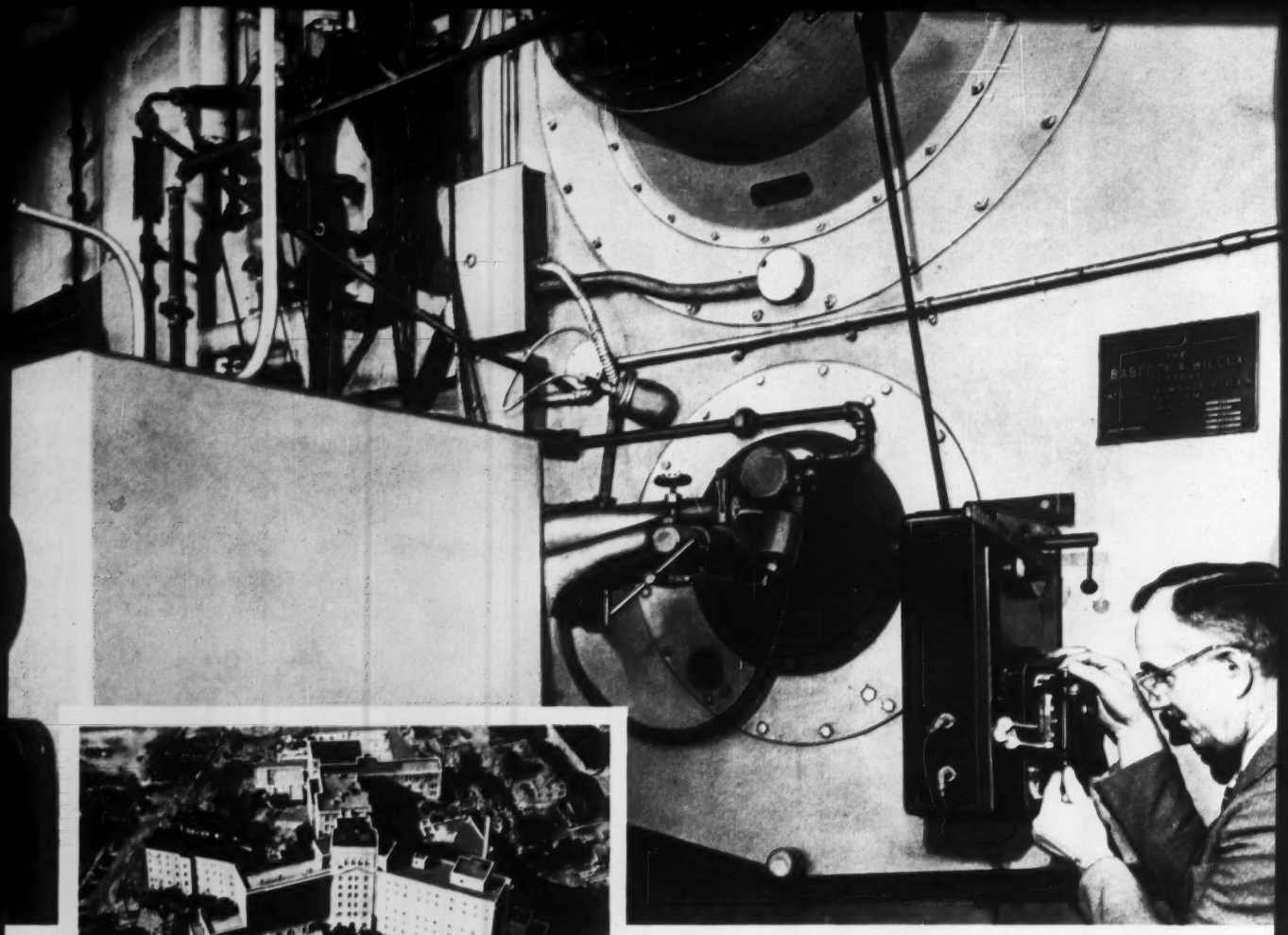
ASME-AIChE Heat Transfer Conference • University Park, Pa. • Aug. 11-15, 1957



Front of B&W Type FM Integral-Furnace Boiler that supplies steam for all services at Monmouth Memorial Hospital, Long Branch, N. J. Vogelbach & Baumann, Jersey City, N. J., Engineers.

Monmouth Memorial Hospital Saves $10,000 a Year

WITH B&W TYPE FM INTEGRAL-FURNACE BOILER

An oil-fired B&W Type FM Integral-Furnace Boiler is saving Monmouth Memorial Hospital $10,000 a year as it supplies clean, dry steam for many uses. This new unit at the 350-bed Long Branch, N. J., voluntary community hospital will pay for itself within four years.

Monmouth's boiler heats the hospital, an 84-bedroom nurses' residence—a separate building apart from the hospital—a clinic, and a 40-suite doctors' office building. It supplies steam for sterilizers, for the main hospital kitchen and 11 floor pantries on a decentralized food-service system that provides 1,250 meals a day, and a laundry processing 8,000 lb of linen a day.

This boiler has the typical B&W boiler quick response to the usual load variations of hospital service. It has a maximum capacity of 22,000 lb of steam per hr and operates at pressures to 125 psi, varied to suit services and to save fuel. A "package" unit, it was completely shop-assembled, requiring only service connections after installation.

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about

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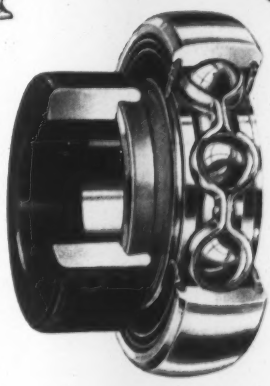
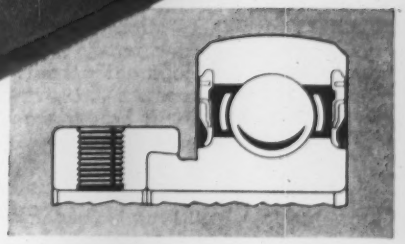


New Departure Pillow Blocks employ the performance-proved New Departure Type AE Adapter ball bearings with spherical O.D. for alignability and steel-reinforced Sentri-Seals for long life protection against dirt or grease leakage.



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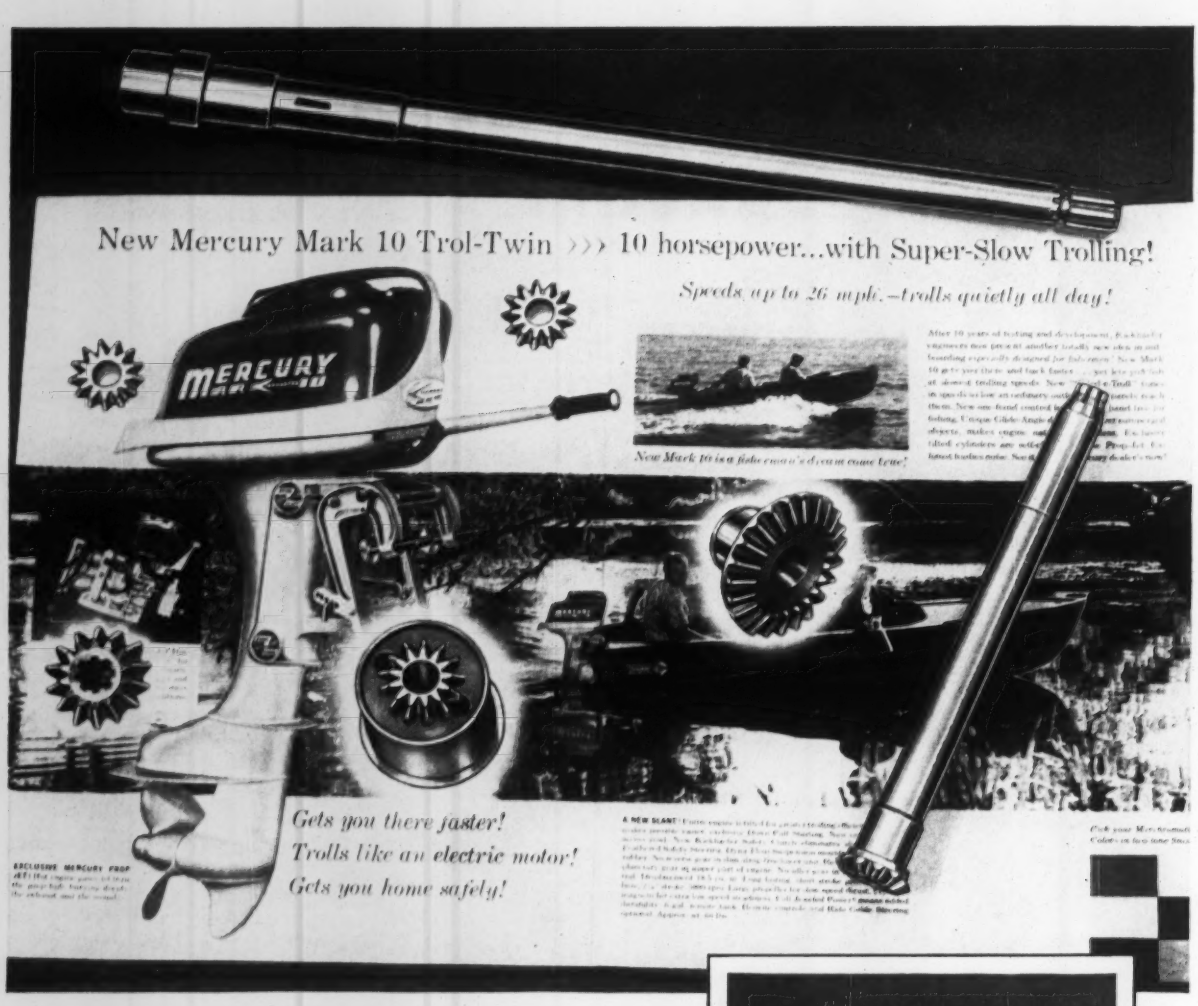
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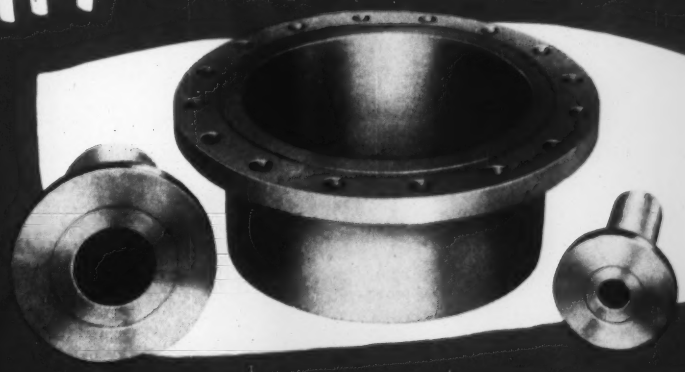

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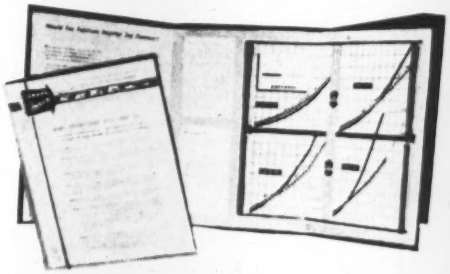

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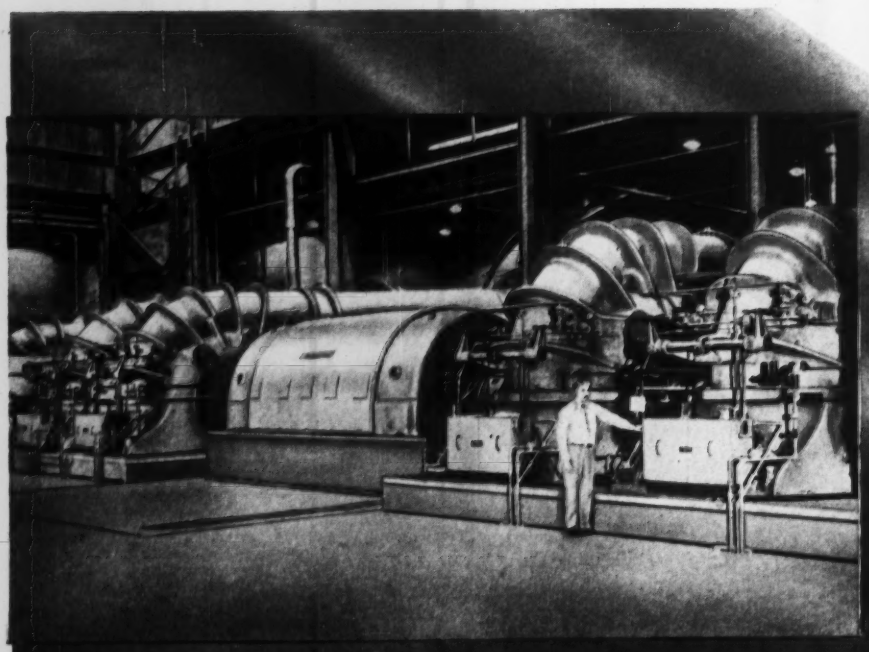
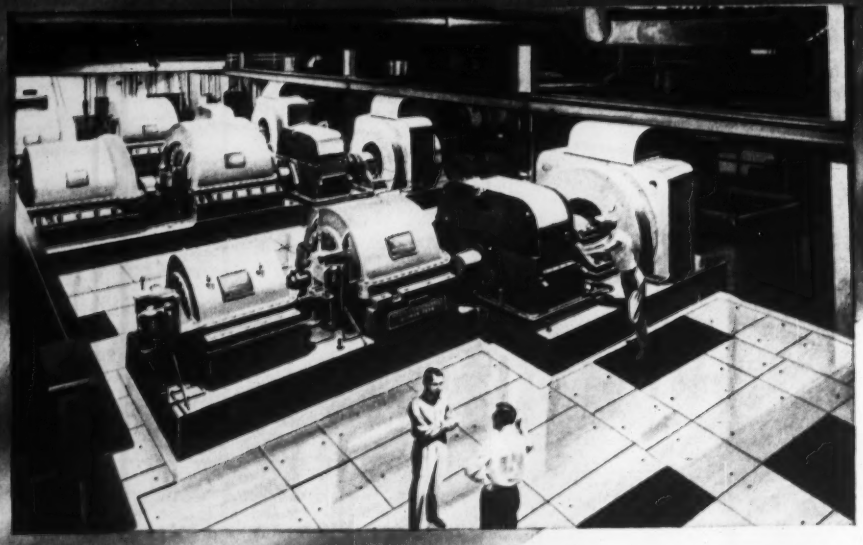


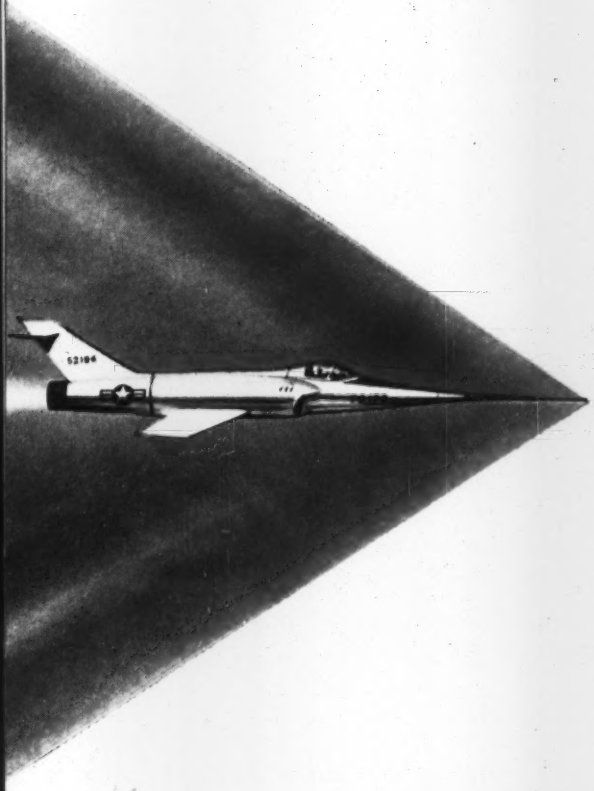
Five R-C single-stage centrifugal blowers developing over 1,000,000 cfm direct driven from electric motors rated at more than 80,000 HP at Langley Field, Virginia.

Six R-C multi-stage blowers rated over 75,000 cfm requiring about 14,000 HP, part of a centrifugal installation at Lewis Flight Propulsion Laboratory in Cleveland.



Roots-Connersville creates

STOP-AND-GO WHIRLWINDS FOR AIRCRAFT RESEARCH



Man-made air masses that match the violence of nature's hurricanes pour from the Roots-Connersville Blowers at the Lewis Flight Propulsion Laboratory of the National Advisory Committee for Aeronautics. Yet the power of these huge wind-making machines can be instantly controlled, from a soft, whispering breeze to a roaring, whirling cyclone. In the reverse, the siphoning air movement can develop almost perfect vacuums to simulate the air conditions of high altitudes. A similar but larger N.A.C.A. "wind-making system" is now being completed at Langley Field, Virginia.

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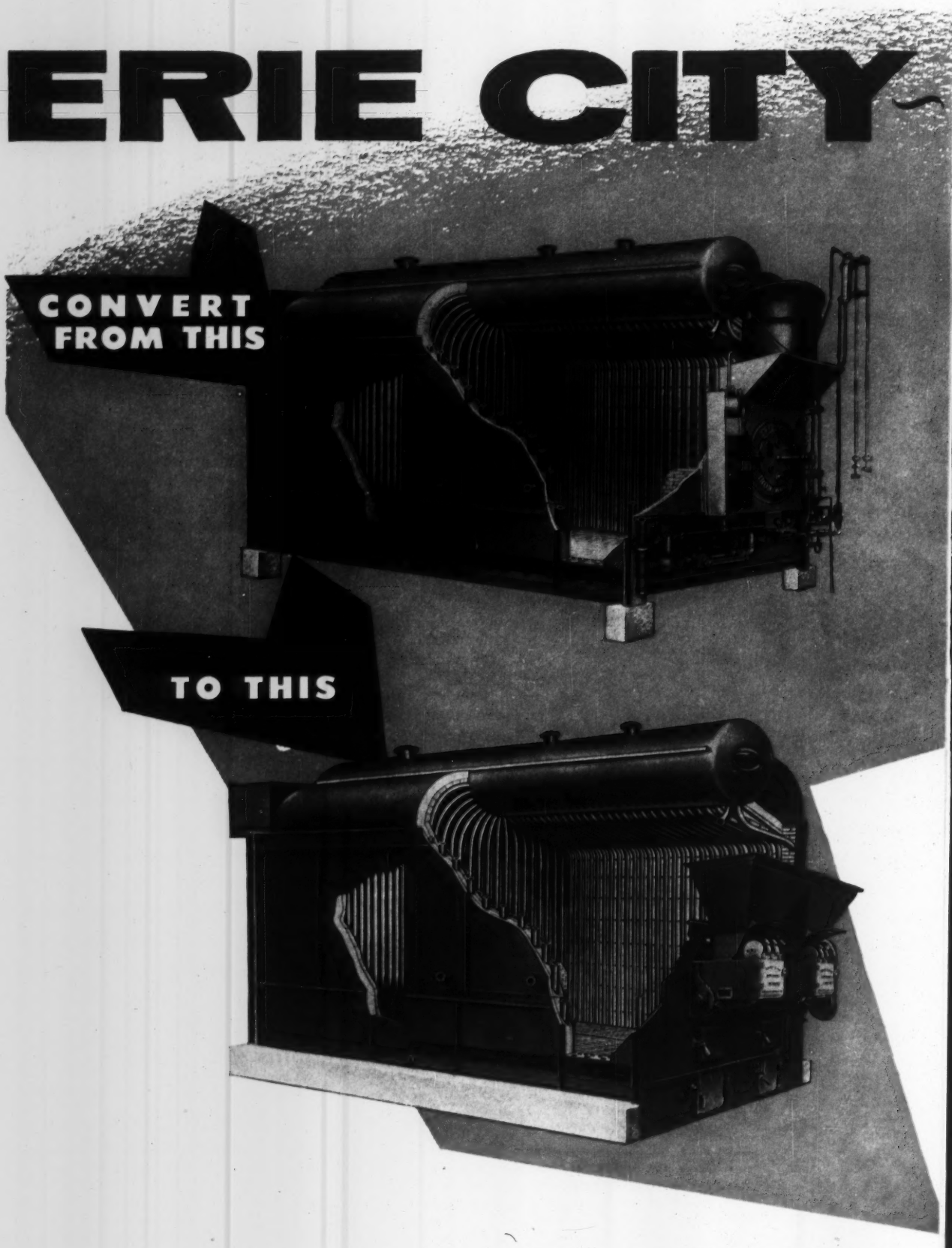
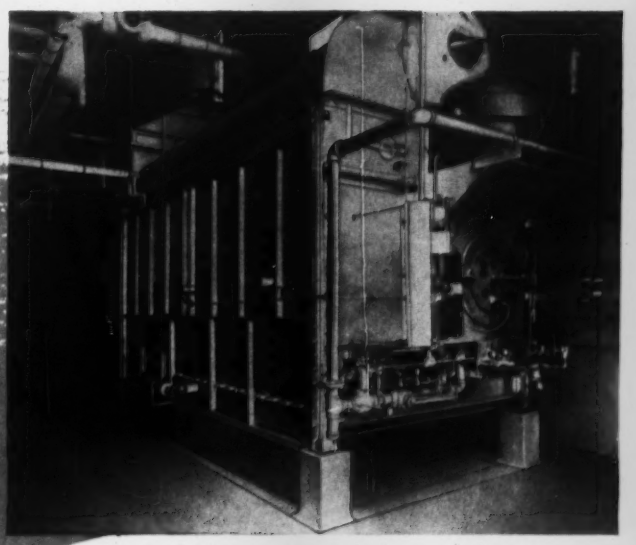


Packaged Boiler

OIL GAS or COAL FIRED



At Charleston Linen Service, Charleston, West Virginia, this Erie City 14,000 lbs/hr. VLP is now fired by Erie City oil and gas burner and will accomodate future stoker firing.

Is your plant ready to install a new package boiler? - - Then look to Erie City for the greatest range of sizes for all types of firing.

Your plant may be located in an area where gas, oil and coal are all available. At first you may want to fire your package boiler with gas and oil—but with the proper provision for future coal firing. The boiler for you to install is the Erie City VLP arranged for present oil and gas firing but with the furnace PROPERLY PROPORTIONED for future stoker firing. Erie City engineers will design your VLP for future conversion to either underfeed or dump grate spreader stoker. Then when you want to switch to coal firing pull out the burner and put into place the properly designed Erie City stoker. This guarantees you "undivided responsibility", for Erie City designs and manufactures a complete line of gas and oil burners and all types of stokers.

When arranged for gas and oil firing, the VLP will come complete with the most modern and effective safety controls and fully modulating, interlocked, electric controls, steam pressure actuated, guaranteeing proper fuel and air supply over the operating range of the unit.

All Erie City Package Boilers are completely factory assembled, piped, wired and Factory Tested with burner and fuel of your choice. They need only basic service connections in the field. For complete data write Dept. 4F.

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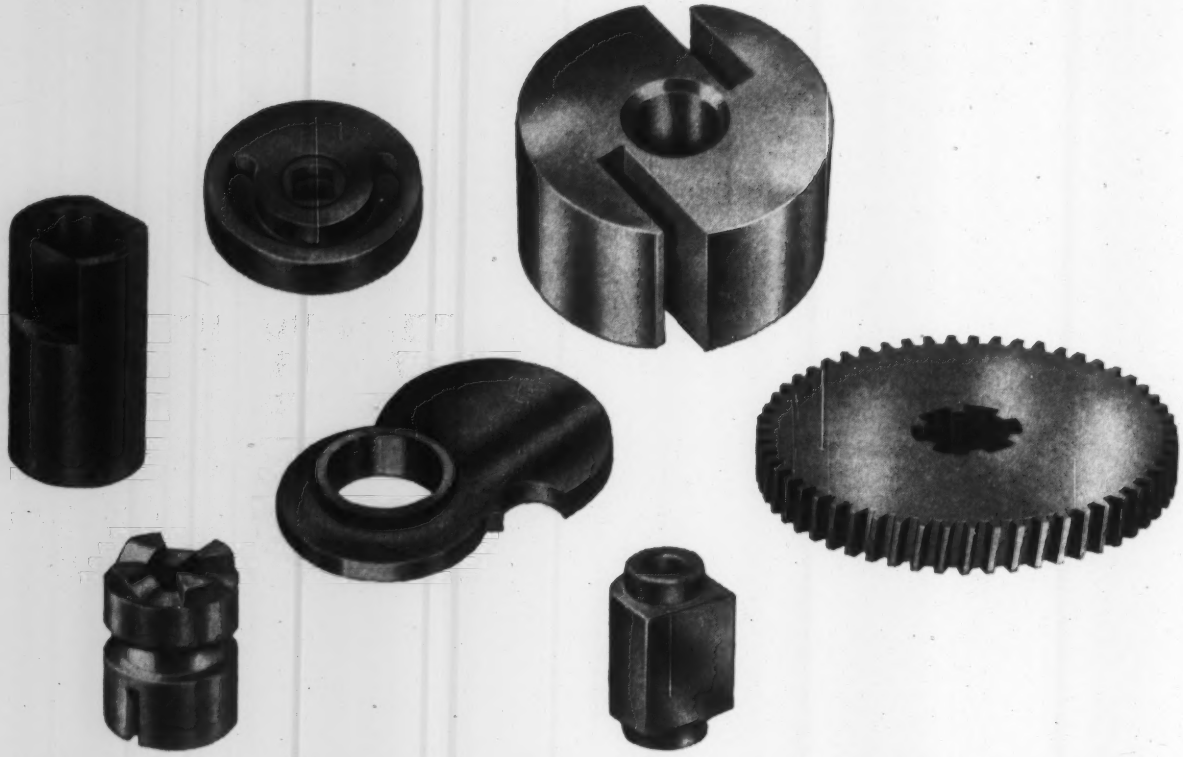

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Were you to machine the above parts from bar stock, or were you to finish them from rough castings or forgings, the cost would be considerable, due to their complex shapes. However, these parts—and thousands of others of comparable complexity—are produced economically by the GRAMIX process. GRAMIX parts are die-pressed to the exact shape desired, with tolerances as close as .0005″, then sintered. Further machining is seldom necessary, though we often perform a coining operation to give the part a burnished, work-hardened surface. GRAMIX parts can be impregnated with various high-grade oils to furnish self-lubrication at wear surfaces. Alloys available include an extensive variety of brass, bronze, and ferrous types, and our manufacturing process allows us to accurately control the density of GRAMIX parts, assuring a uniform structure. There is probably a component in your product that could be improved with GRAMIX sintered metal parts . . . Have you given it consideration?

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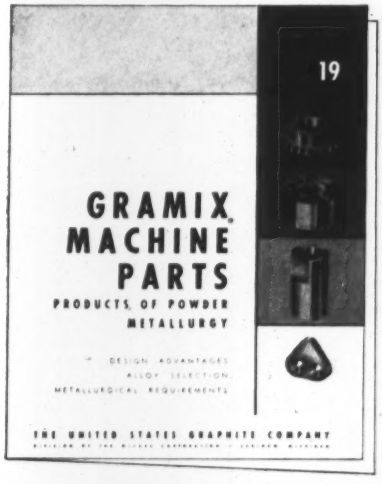

ENGINEERING BULLETIN No. 19

Product engineers specifying materials will find a wealth of design information in this GRAMIX Machine Parts Bulletin. This material is presented in such concise form that questions are quickly and easily answered. A simple chart indicates which alloys—ferrous and non-ferrous—are suitable for different operating requirements. Working sketches show the various design possibilities—radii, helical teeth, dead-end holes, flanges, multiple shoulders—and how they can be utilized to best advantage. Physical properties are presented, and metallography discussed. In all, you'll find Bulletin 19 an ideally simplified guide to a complex subject . . . write now for your copy. 118

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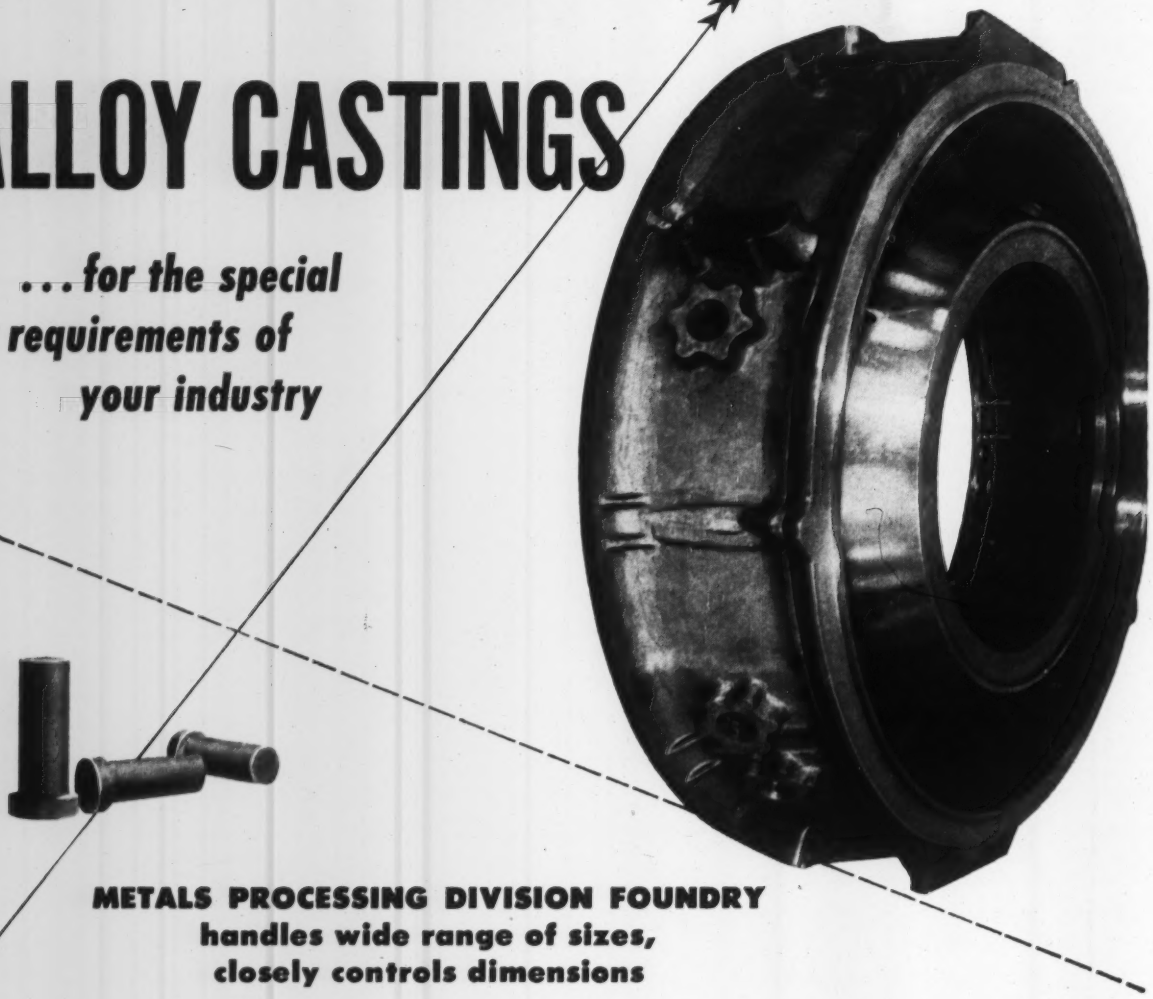

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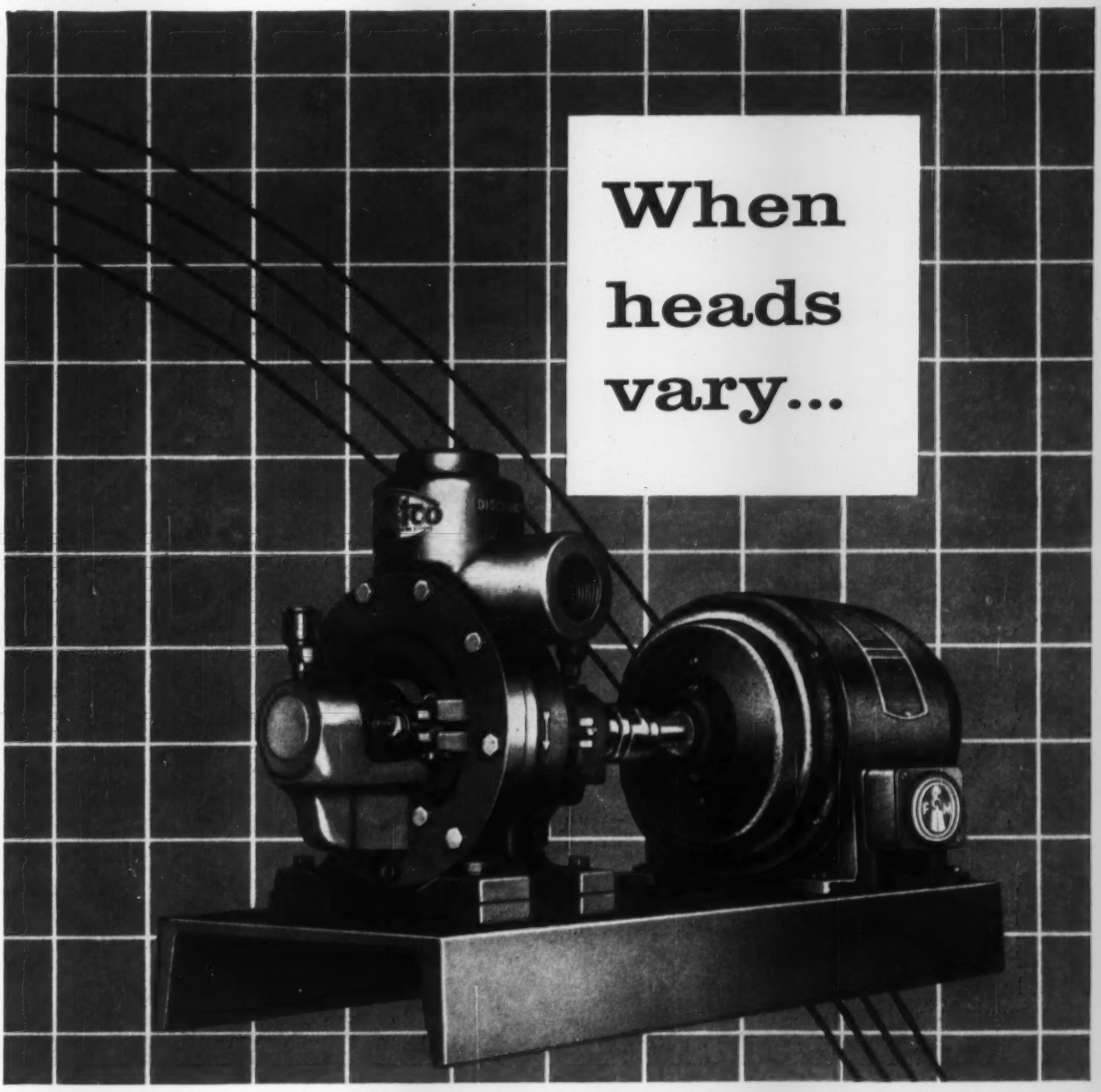

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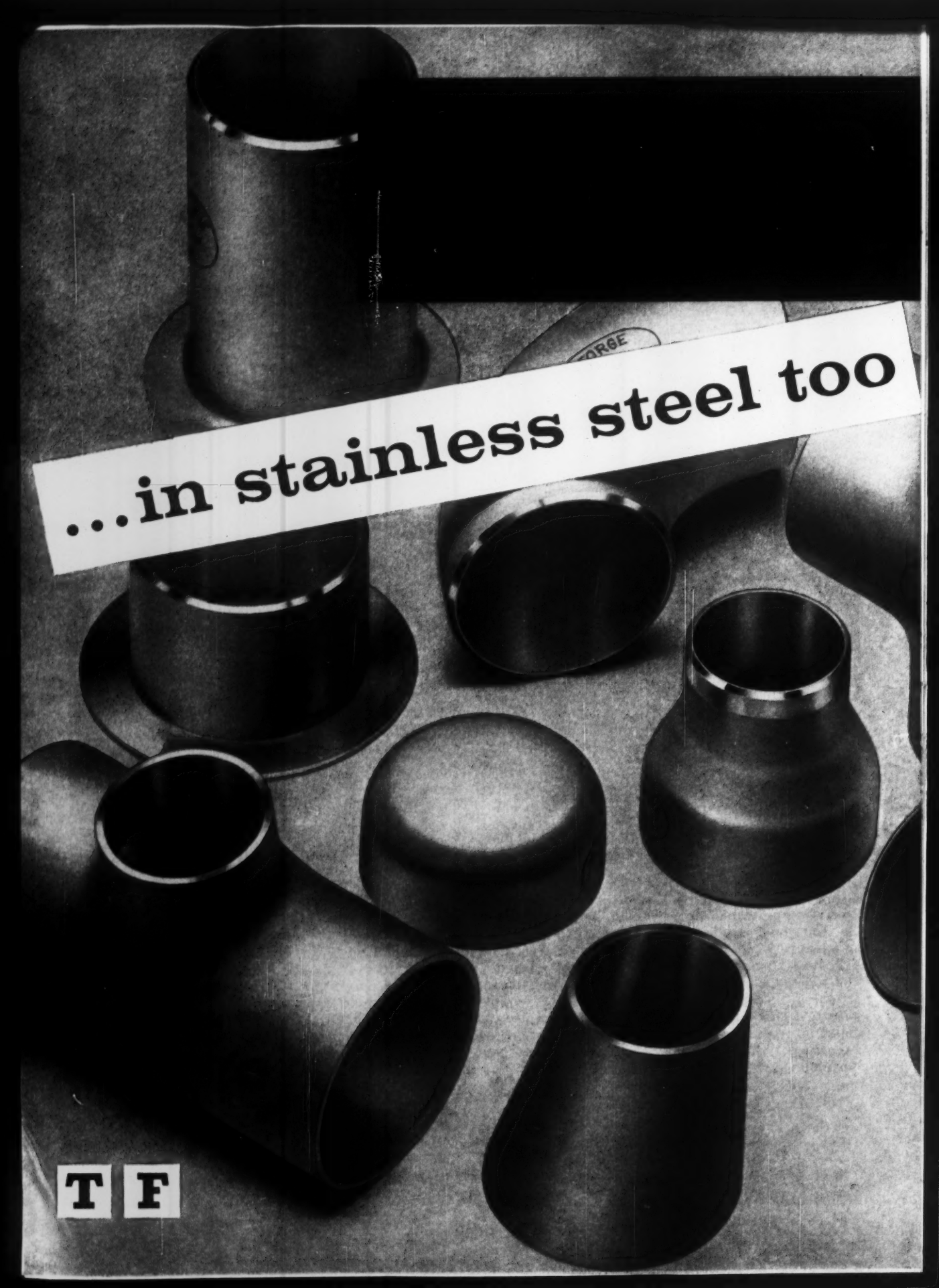
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* Schedules 5S—10S—40S—80S as well as all sizes and thicknesses covered by Standards in carbon steel.

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*NOTE: Schedules 5S and 10S 90° and 45° WeldELLS are furnished seamless in sizes through 6". Schedules 40S and 80S are furnished seamless in all sizes.

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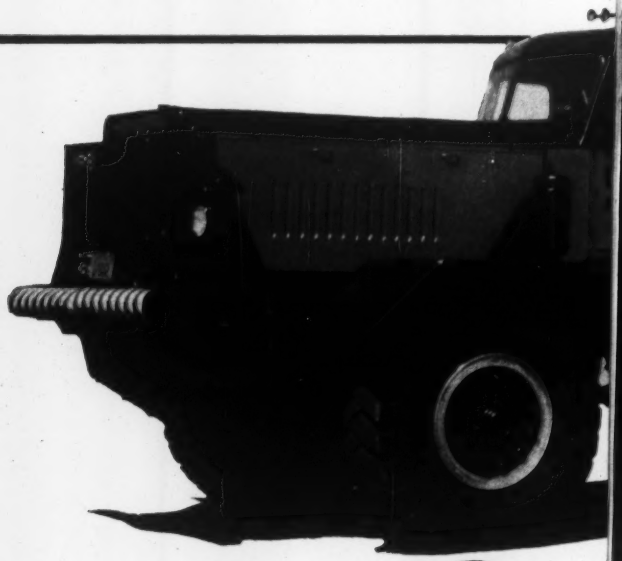
Meets high formability requirements —saves 24% weight

Here's a job that may surprise quite a few steel users accustomed to thinking of high strength steel as being "stiff" and therefore not readily formable. For in making these LP-gas containers, USS MAN-TEN Steel blanks ¼" thick are press-formed *cold* into seamless shells, 29" in diameter and 24" deep. Such an operation calls for a degree of formability that would be considered high even for carbon steel.

By taking advantage of this property, Pressed Steel Tank Co., Milwaukee, Wisc., was able to reduce the shell thickness of this Hacknay container 24%, and at no increase in cost, produce a stronger, tougher and more durable container that is 102 lbs. lighter than when made of carbon steel. This saving in weight means easier handling in the shop and during installation, plus substantial savings in freight costs—both on the steel used and when finished containers are shipped.

Assures greater portability, prolongs life

In portable oil drilling rigs like this, every pound of weight saved is of vital importance. To keep weight as low as possible without sacrificing ruggedness, the Cardwell Mfg. Co., of Wichita, Kansas, has built the trailer frame and working platform of USS MAN-TEN Steel and reduced weight 6,000 lbs. as compared to structural carbon steel construction. In the 96-foot mast, which can be telescoped and folded down when the rig is moved, MAN-TEN Steel used in all the structural members reduces weight about 25%, and helps to keep moving costs down to a minimum. MAN-TEN Steel's superior strength and abrasion resistance, plus its high fatigue strength, also pay off by keeping the rig steadily on the job.



UNITED STATES STEEL
USS HIGH STRENGTH STEELS
1933 195
24 YEARS OF PERFORMANCE

USS MAN-TEN Steel—the low cost way to build better performance into equipment like this

IN THE PAST 24 YEARS, USS MAN-TEN Steel has earned the high regard of design engineers—and for good reason.

Faced with the knotty problem of improving equipment, while at the same time keeping down its cost, they have found that with USS MAN-TEN Steel they not only could materially reduce weight—or greatly increase strength and durability—but often could do so at *lower* cost than with structural carbon steel.

For USS MAN-TEN Steel, although it costs only about 25% more, has a yield point at least one and one half times that of structural carbon steel. It has greater abrasion resistance. Its fatigue strength is about 40% higher. Its resistance to atmospheric corrosion is twice that of carbon steel. In addition, USS MAN-TEN Steel is more readily worked and welded than structural carbon steel of the same strength level.

Thus when MAN-TEN Steel is used in the same thickness as structural carbon steel, it will increase strength 50% at only about 25% increase in material cost. And when used in 20 to 25% thinner sections, MAN-TEN Steel construction, though lighter, may be designed for *both* greater strength and lower cost.

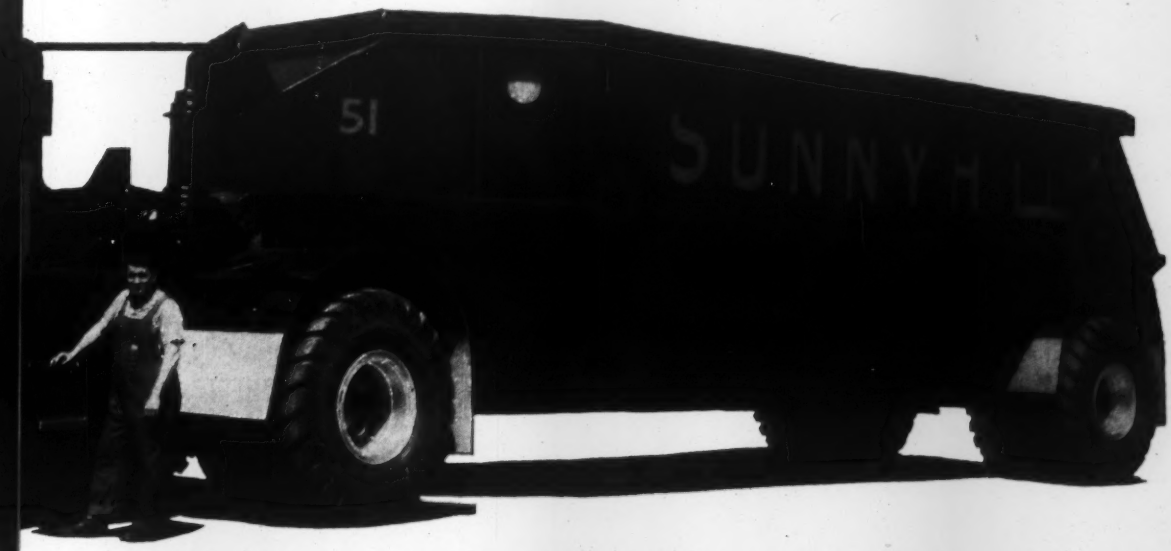
The increased working capacity, longer life and greater freedom from maintenance its use ensures are money-saving advantages that pay off BIG in customer satisfaction and increased salability.

To find out how you can incorporate USS MAN-TEN High Strength Steel in your designs most efficiently and economically, send for our 174-page "Design Manual for High Strength Steels." This authoritative book covers every facet of this important subject. For your free copy, write—*on your company letterhead*, giving your title or department—to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

Cuts weight 15%, increases payload capacity 15%

This 50-ton Dart coal hauler is a classic example of how USS MAN-TEN Steel can solve a difficult weight problem. Large trucks like this are generally designed right up to the limit of tire capacity. In other words, their size is largely determined by the maximum combined weight of truck and payload that the tires can safely carry. Thus the 15% reduction in body weight made possible by lighter MAN-TEN Steel construction, by lifting that much weight off the tires, enabled the designers to increase the payload capacity by a highly desirable 15% so that the truck is able to carry a huge 50-ton load on rough, off-road hauls without undue jeopardy to tire life.

Ten trucks like this, built by Dart Truck Company, Kansas City, Kansas, have been in use more than three years at Sunnyhill Coal Company's New Lexington, Ohio, workings. Each hauls an average 120,468 tons per year. To date, none has required repair of any kind. All are still in perfect condition.



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NATIONAL TUBE DIVISION, PITTSBURGH • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS HIGH STRENGTH STEELS

USS MAN-TEN • USS COR-TEN • USS TRI-TEN

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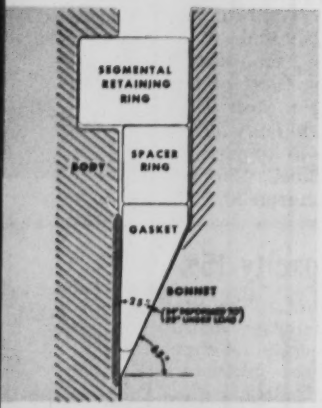
7-1022

UNITED STATES STEEL

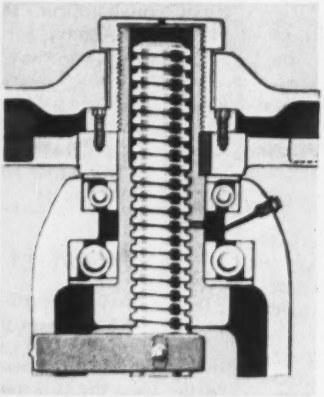
How To Get SPECIAL Features

Tips on selection, installation and operation of steel



NON-LEAK PRESSURE-SEAL BONNET JOINT

By changing bonnet-gasket angle from 45 degrees to shape shown, sealing area is increased 300%, sealing force doubled. Soft iron gasket is electroplated with a lead alloy which flows under pressure, assures tight seal. No sharp gasket edge to damage. Easily disassembled.

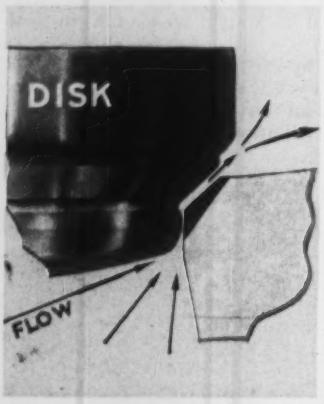


EVALTHRUST* BALL-BEARING CONSTRUCTION

This patented ball-bearing construction is found in all large, high-pressure Edward Valves. Double races on the yoke stem reduce operating torque . . . effectively transmit highest closing torques. An Edward "exclusive."

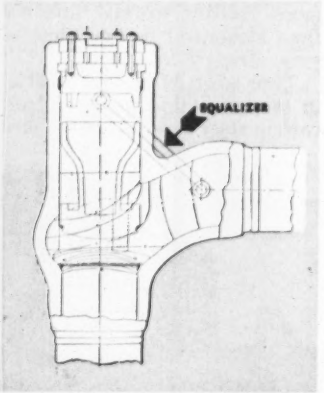
LEAK-PROOF INTEGRAL SEAT

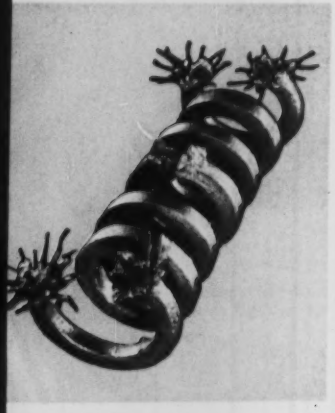
Integral Stellite seat in Edward Valves cuts maintenance, prevents leakage between seat and body. For perfect alignment, applied Stellite is precision-machined in same set-up as body bore, then carefully lapped to form drop-tight mated seating surfaces.



ORIGINAL-DESIGN EDWARD EQUALIZER

For check and non-return valves, the Edward Equalizer connects the high-pressure area above disk-piston with the high-velocity, low-pressure area in the valve outlet. Increases disk lift, cuts pressure drop, reduces disk vibration.





EVALPAK* PREMIUM VALVE PACKING

Edward developed the *first* asbestos-graphite packing with special processing to prevent stem pitting. Die-molded to fit exactly the stem and stuffing box, it is wire-supported and features low operating torque. Durable, easily replaceable.

IMPACTOR* HANDWHEEL

Exclusive Impactor* handwheel multiplies the closing force a man can deliver, assures tight seating with minimum effort in minimum space. Often eliminates need for bulky, expensive gearing or motors.

*Reg. T.M., Edward Valves, Inc.

Rockwell-Built Edward Valves

in STANDARD Steel Valves

valves from Edward, long-time leader in the field

We all know that no one gets "something for nothing." Yet, by careful evaluation and selection, it *is* possible to obtain "special" features in *standard* steel valves. The secret lies in buying "by company" as well as by price. In dealing with Edward, whose products have been the industry's standard of excellence for years, you avail yourself of three important benefits:

1. access to the results of continuing laboratory research on steel valves;

2. expert assistance on valve selection, installation, operation, maintenance and repair;

3. steel valves which are truly superior in design, function and durability . . . but which are not substantially more expensive than ordinary types.

For example . . . a half-dozen "special valve" features —which are *standard* in Edward Valves—are shown in handy clip-out form on the opposite page. ALL of these features are Edward "firsts" . . . MOST are Edward "exclusives" . . . EACH means *extra value* for you!

We invite you to consult your Edward Valve Representative. He is technically trained, thoroughly experienced, eager to help you obtain the *most* value for your valve dollar. At his disposal—and yours—are the results of substantial investment in steel valve research. Let him *use* those results to solve your problems. A card or a call will bring him "on the double" . . . so make it a point to contact us *now!*

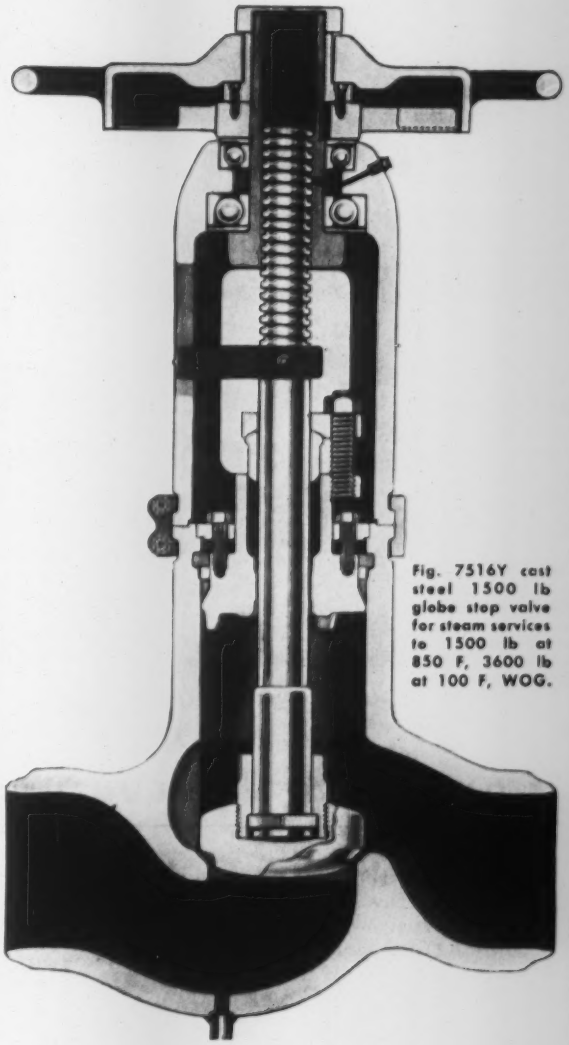
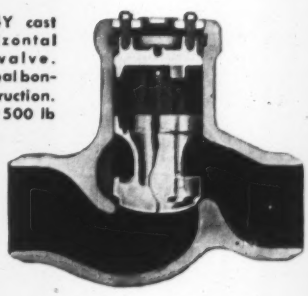


Fig. 7516Y cast steel 1500 lb globe stop valve for steam services to 1500 lb at 850 F, 3600 lb at 100 F, WOG.

Edward builds a complete line of forged and cast steel valves from ⅛" to 16" in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs for pressures up to 7500 lb with pressure-seal, bolted, union or welded bonnets and screwed, welding, or flanged ends.

Fig. 7594Y cast steel horizontal check valve. Pressure-seal bonnet construction. Rated at 1500 lb at 850 F.

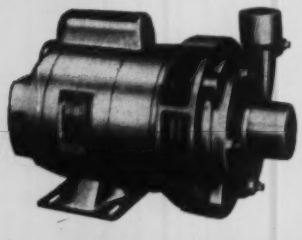


Edward Valves, Inc.

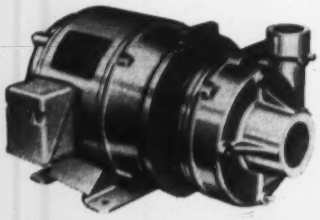
Subsidiary of **ROCKWELL MANUFACTURING COMPANY**

1228 West 145th Street, EAST CHICAGO, INDIANA

For PUMPS *you just can't beat the Line that's Complete*

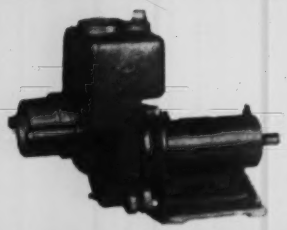


TYPE PE-A ¼-1½ hp. Facemount design NEW NEMA type motor. Compact, efficient, shaft seal equipped.

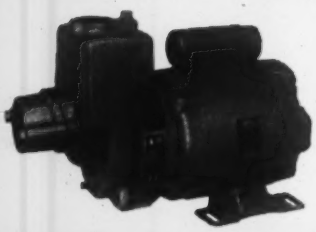


TYPE PE-200 2, 3, 5, 7½ hp. Economical, compact. Facemount design. Versatile, good looking.

TYPE PN ¼, ⅓, ½ hp. For low head pumping. Shaft seal equipped. New facemount NEMA type motor.



TYPE BSP ¾ hp. Close coupled, selfpriming pump. Excellently suited to high capacity pumping.



TYPE ESP ½, ¾, 1 hp. Facemount design. Ideal for swimming pools. Versatile, shaft seal equipped.

TYPE CP & TCP Vertical flanged suction pump. Open or explosion-proof motors. ¼ to 7½ hp. Excellent ratings.

Types, sizes, models for every need on every job!

PEERLESS GENERAL PURPOSE *Fluidyne*® PUMPS

They all have built-in quality,—that's Peerless craftsmanship. They all have excellent performance ratings,—that's Peerless efficiency. They all have remarkably trouble-free operating records,—that's Peerless dependability. They all are quality engineered, reasonably priced,—that's Peerless economy. And all are quickly available from two big factories,—that's Peerless service. Get the facts today.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles 31, California and Indianapolis 8, Indiana

fmc

PEERLESS PUMPS

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
2005 Northwestern Avenue, Indianapolis 8, Ind.
or 301 West Avenue 26,
Los Angeles 31, California.

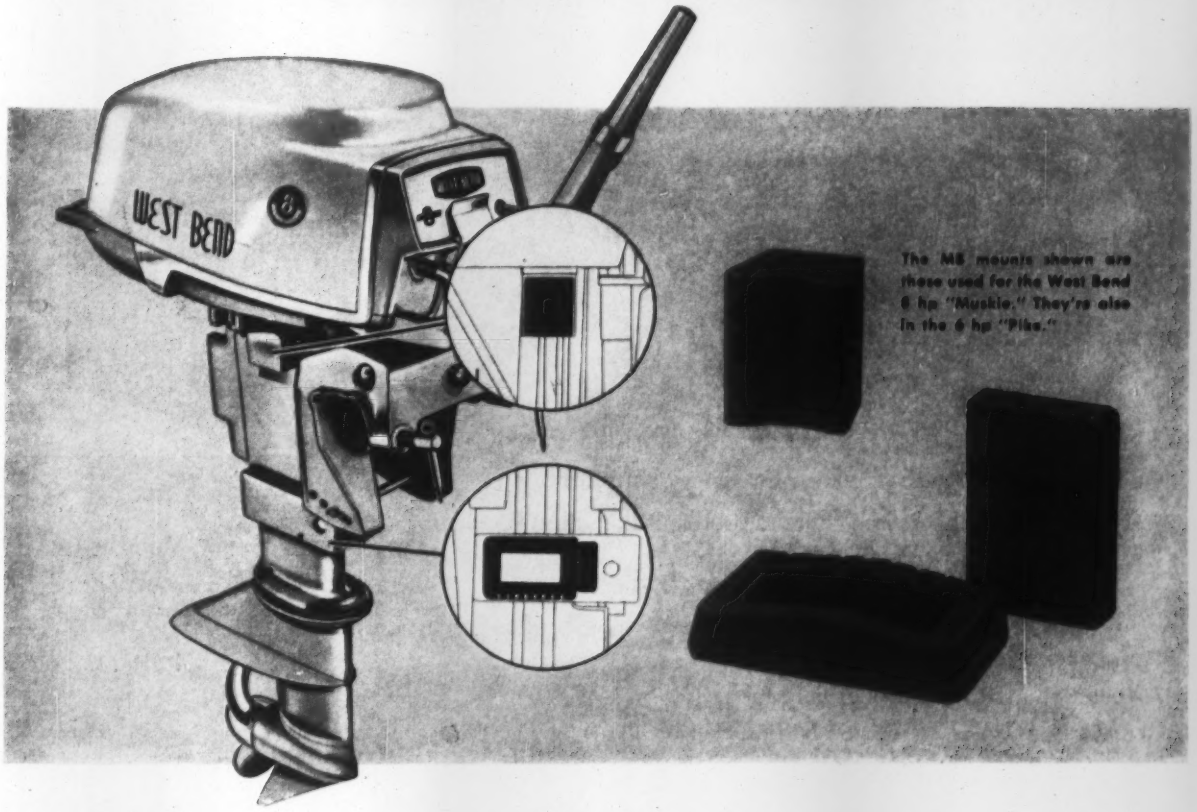
Please send bulletins on pumps checked below

☐ Type PEA ☐ Type PE 200 ☐ Type PN
☐ Type BSP ☐ Type ESP ☐ Type CP
☐ Complete Line

Name_____
Company_____
Address_____
City_____ State_____
ME

PUMP	HP	CAPACITIES	HEADS
PEA	¼-1½	to 65 gpm	to 110 ft.
PE 200	2, 3, 5, 7½	to 190 gpm	to 140 ft.
PN	¼, ⅓, ½	to 60 gpm	to 30 ft.
BSP	¾	to 78 gpm	to 55 ft.
ESP	½, ¾, 1	to 69 gpm	to 50 ft.
CP	¼-7½	to 250 gpm	to 100 ft.

this *smooth power* floats on MB mounts



WEST BEND outboard motors for 1957 feature new colors, wider range of ratings. But one thing doesn't change: Their freedom from annoying vibration. Special MB vibration mountings, as they have for years, isolate motor from boat.

Satisfactory isolation of outboards can be difficult to achieve. Modes of motion are rougher; underwater service conditions are hardly ideal; and the location of suspension points is relatively restricted. Specially engineered, all-neoprene MB mounts overcome these problems...taming torque from engine, and cushioning impulse from propeller.

MB concentrates on mounts which start where ordinary units have to give up. While *standard* units are available, MB mounts are actually in the *special performance* class. Perhaps we can work out a modification of one to solve *your* troublesome vibration problem. Send for Bulletin 616A.

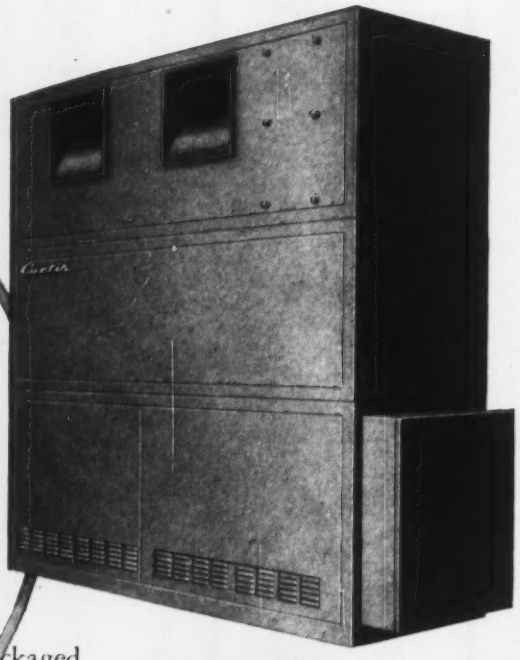
manufacturing company
A Division of Textron Inc.
1074 State Street
New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO ISOLATE VIBRATION...TO EXCITE IT...TO MEASURE IT.

NOW!

Curtis

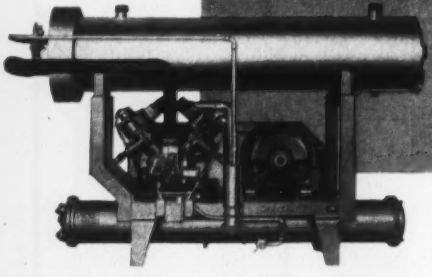
PACKAGED UNITS
Up to 50 Tons
OPENS NEW MARKETS FOR PACKAGED AIR CONDITIONING



No question about it. The new 50-ton Curtis packaged air conditioner will open a new sales front for you. Architects, engineers *and* owners prefer packaged units for important reasons:

- Big package units are line assembled—does away with expense of field labor. Assures a BALANCED SYSTEM.
- Packaged units are easier to install—take up less space.
- Cuts down installation problems and maintenance costs.

IMPROVED PACKAGED LIQUID CHILLER... FOR WET HEAT SYSTEMS



up to 100 tons—

With all controls in single panel box for easier access and greater protection! Four step capacity control—unloaded starting available. Particularly desirable where year 'round conditioning of multiple individual rooms is required.

REMEMBER, every Curtis unit is backed by a solid 103 years of experience and skill. Curtis offers a complete line of air conditioning equipment—nationally advertised to help you sell.

YOU CAN COUNT ON

REMEMBER... **Curtis**

OUR 103rd YEAR

MANUFACTURING COMPANY
REFRIGERATION DIVISION
1940 Kienlen Ave. St. Louis 20, Mo.
CM-16

New Curtis Packaged, Air Cooled, Air Conditioning Units, 3 thru 7½ tons. Residential and commercial applications.

Condensing Units up to 100 tons. F-12 or F-22.

Air Handling Units, Cooling Towers and Evaporative Condensers to match.

Strobotac® *Checks Speed Torque Characteristics of VARD Magnetic Clutch*

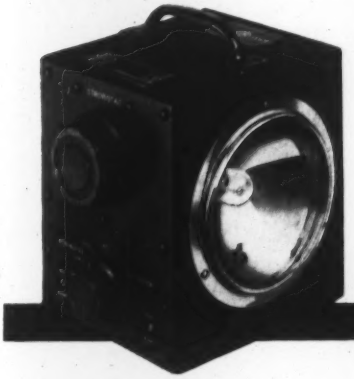
Strobotac makes it possible to see rapidly moving parts and mechanisms as though they were operating in s-l-o-w motion or actually standing still. The instrument operates from usual 105 to 125v, 60c lines . . . is 7⅝ x 9 x 10 inches . . . weighs less than 10 pounds.

Range: Direct reading 600 to 14,400 rpm
Useful 60 to 100,000 rpm.

Flash Duration: 10 to 40 microseconds.

Accuracy: ±1% of scale
Built-in calibration system.

Type 631-BL Strobotac.....$160



Developed for auto-pilots and countless other servomechanism applications, the Vard clutch depends for its operation on a magnetically induced torque accomplished in much the same manner as in an induction motor. It is controlled by variable d-c excitation which requires about five-percent of the power being transmitted at any nominal speed — thus actuator gearbox outputs are readily regulated for almost any need.

Vard uses the Strobotac to check rotational speed accurately, and to establish steady-state, speed-torque characteristics. From this data the effects of other clutch constants — cage resistance, reactance and the like — can be anticipated and controlled.

Strobotac measures the speed of rotating, reciprocating, or other cyclic motions with accuracy. The operator can "stop" the moving part completely — study it in slow motion — or measure its rpm while it is running at full speed. There is no mechanical connection to induce even a slight "drag" in low-powered mechanisms.

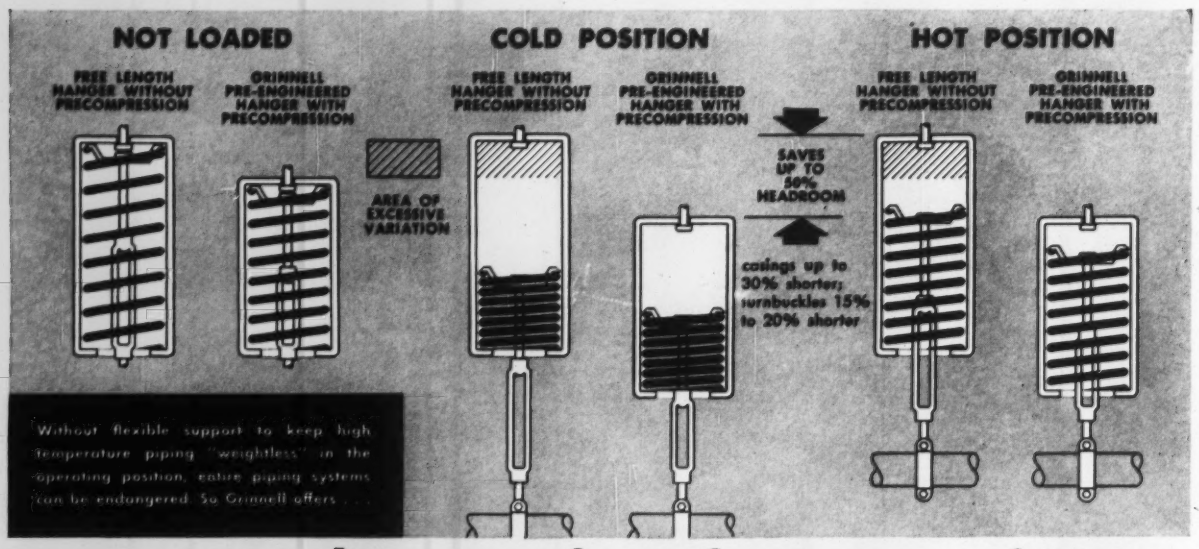
All over the world, Strobotac helps solve research and design problems. This "laboratory" instrument is also a prime industrial tool for maintaining production, quality control, and diagnosing all kinds of mechanical troubles.

Write for the **STROBOSCOPE BULLETIN** and complete information

GR® General Radio Company

275 Massachusetts Avenue, Cambridge 39, Mass., U.S.A.

Broad Avenue at Linden, Ridgefield, N. J. **NEW YORK AREA**
8055 13th St., Silver Spring, Md. **WASHINGTON, D. C.**
1182 Los Altos Ave., Los Altos, California **SAN FRANCISCO**
1000 N. Seward St. **LOS ANGELES 38**
1150 York Road, Abington, Pa. **PHILADELPHIA**
6605 W. North Ave., Oak Park **CHICAGO**


NOT LOADED
COLD POSITION
HOT POSITION
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
AREA OF EXCESSIVE VARIATION
SAVES UP TO 50% HEADROOM
casings up to 30% shorter; turnbuckles 15% to 20% shorter
Without flexible support to keep high temperature piping "weightless" in the operating position, entire piping systems can be endangered. So Grinnell offers . . .

Precompressed Hangers for Safer Support of Piping

Helical coil springs are widely used in hangers for flexible support of piping which moves up or down during thermal expansion. The A.S.A. code for pressure piping requires that variable spring hangers support at least a minimum of 75% of the pipe's weight for a pipe that rises (relaxing the spring) and no more than 125% of the pipe's weight for a pipe that lowers (compressing the spring) during operation.

Precompression patented Grinnell principle

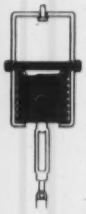
To guard against the spring's supporting force exceeding the limits of variation, Grinnell developed and patented a variable spring hanger design. The steel casing holds the spring permanently precompressed, at the threshold of the hanger's working load range. This prevents the spring decompressing into its area of excessive variation.

Pre-set is not a substitute

As a partial substitute for this patented precompression, some manufacturers insert a spacer between the top end of a free-length hanger casing and the spring to hold the spring's height temporarily within the working range during shipment and erection.

Another device requires the manufacturer to drill symmetrically opposite holes in the casing walls and insert a bolt to hold the spring's height within the working range. When these devices are removed from the hanger and discarded, the spring can decompress, resulting in high variability in supporting force.

Cold-setting a universal factory service

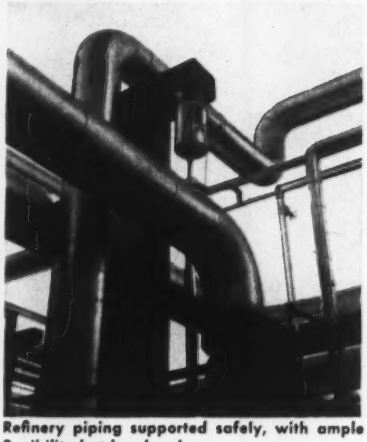


For the erection crew to avoid having to compress the spring down to the erected position, the manufacturer can compress the spring down to this height. Grinnell can provide a cold-set bolt in precompressed hangers.

Less headroom required by Grinnell Hangers

Shorter hanger casings made possible by Grinnell's patented precompression, reduce bulk shipping weight and required headroom by eliminating undesirable height. Installation is simplified by this shorter casing and also by an integral load scale with load indicator.

Additional headroom is saved by a correspondingly shorter turnbuckle. These precompression advantages are available in short spring and double spring models as well as standard spring models.



Refinery piping supported safely, with ample flexibility but low headroom.

Available in 63 standard units

Grinnell Variable Spring Hangers are available in 21 sizes each of short, standard and double spring models . . . for maximum travel of 1¼, 2½ and 5 inches respectively within working load ranges. Load capacities extend from 43 lbs to 30,550 lbs. The maximum variation in the standard size per ½-inch deflection is 10½% of rated capacity; inversely proportional in short spring and double spring models.

For further information

If you have a pipe suspension problem, you are invited to write: — Grinnell Company, Inc., 254 West Exchange Street, Providence, R. I.

~~ABEC-5~~

ABEC-7

Now... every bearing you buy from New Hampshire Ball Bearings, Inc., meets ***CLASS 7 STANDARDS*** *...automatically... at no increase in price...with no special selection or specification required!*

INNER RING

OUTER RING

ABEC-7 TOLERANCES

MEASUREMENT	TOLERANCE
Bore	+ .00000″ − .00015″
Width (Individual Rings)	+ .000″ − .005″*
Radial Runout (TIR) Max.	.0001″
Parallelism of Sides	.0001″
Side Runout with Bore	.0001″
Groove Parallelism with Side	.0001″
O. D.	+ .00000″ − .00015″
Width (Individual Rings)	+ .000″ − .005″*
Radial Runout (TIR) Max.	.0001″
Parallelism of Sides	.0001″
O. D. Runout with Side	.00015″
Groove Parallelism with Side	.0002″

**Width tolerance for MICRO bearings is + .000″ − .001″*

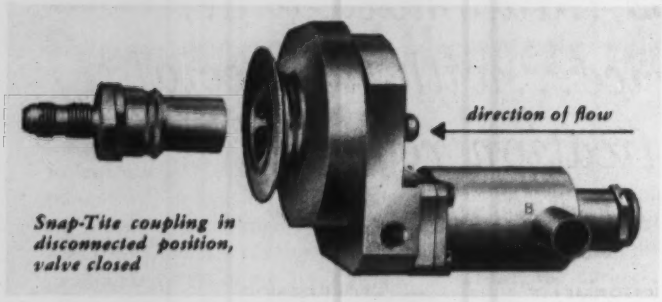
Commonly obtainable standards of precision in the miniature bearing industry start at ABEC-5 and the highest refinement is reached with ABEC-7.

Continued advances in our techniques and controls have enabled us to standardize all production of Micro-Bearings at this highest quality level.

NEW HAMPSHIRE BALL BEARINGS, INC.

PETERBOROUGH, NEW HAMPSHIRE

SNAP-TITE REMOTE CONTROL COUPLINGS FOR GUIDED MISSILES



Snap-Tite coupling in disconnected position, valve closed

Here is a specially designed Snap-Tite quick-connect, quick-disconnect coupling, ideal for use in missile-fueling systems. This unit is specifically designed to be manual-connected . . . can also be disconnected manually, or by use of an air-actuated remote control.

NOT A DROP SPILLED!

When the coupling is disconnected, it spills only that small amount of fluid which clings to the metal. The valves in both the coupler and nipple automatically shut off when disconnected, *with no leakage.*

NO AIR INCLUSION!

Coupling operation encloses only a minute amount of air.

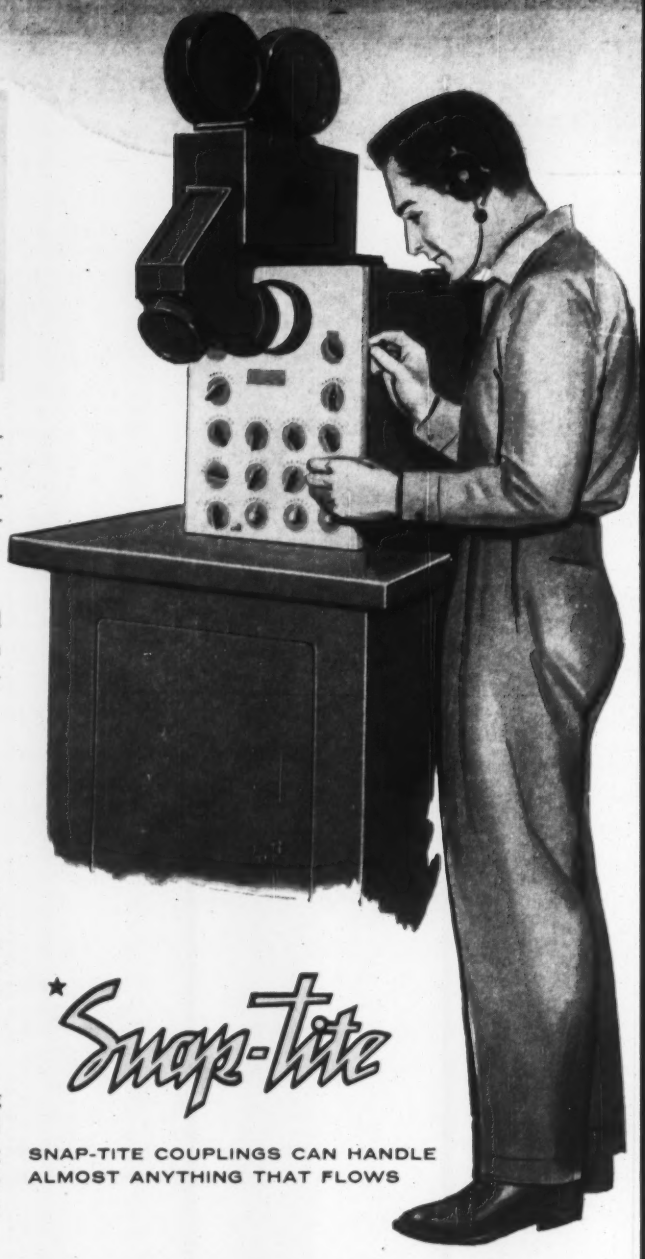
MINIMUM PRESSURE DROP!

Smooth, streamlined passages assure maximum flow.

Variations of this coupling, to meet your required specifications, can be furnished with the appropriate seals to handle liquified gasses, exotic fuels, and a large variety of fluids with working pressures up to 3,000 PSI and temperatures from −300°F to +400°F. Units have been designed up to and including 5″ size.

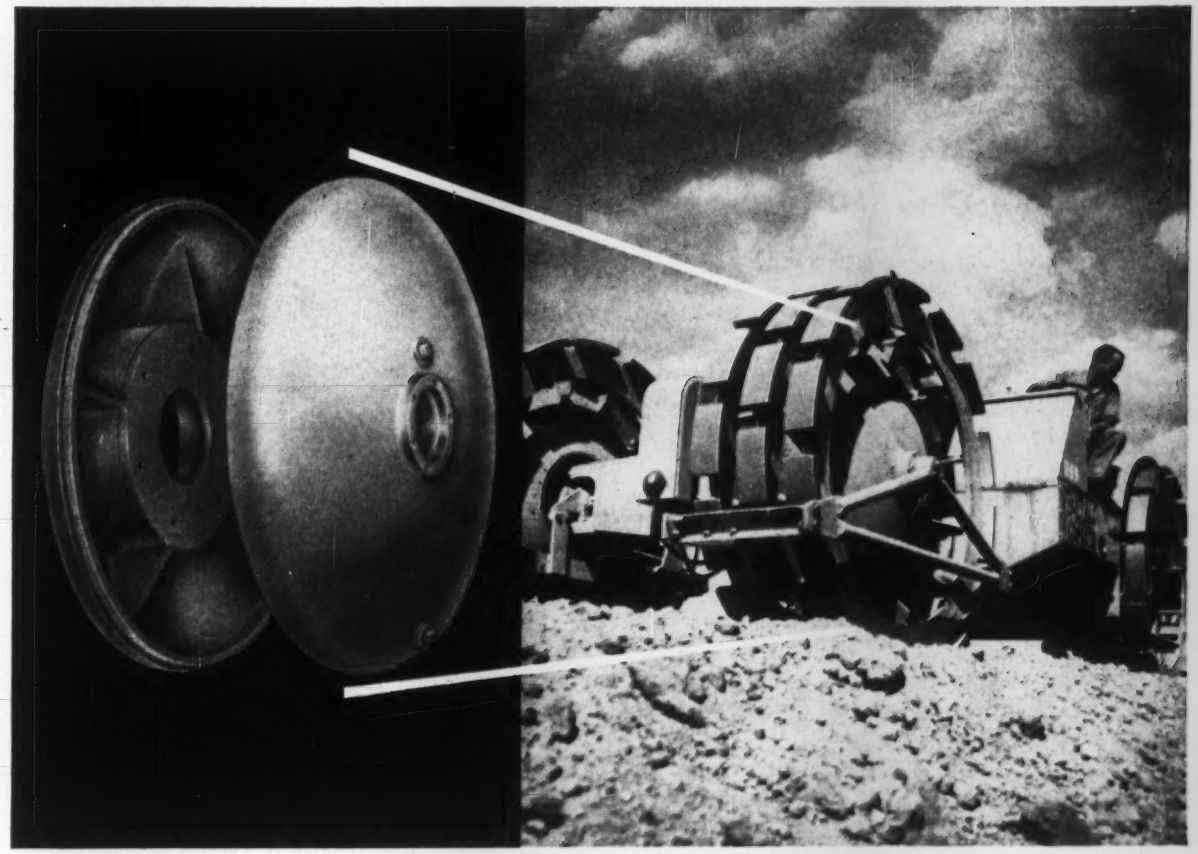
STANDARD COUPLINGS, TOO!

Your coupling needs might not be as critical as the coupling shown here, but you can be sure, when buying standard Snap-Tite couplings, that the same outstanding engineering and manufacturing skills are basic throughout the Snap-Tite line. Write for complete catalog . . . or describe your specific coupling problems. Snap-Tite, Inc., Union City 4, Pa.



★Snap-Tite

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS



Designing the wheels of their unique "Kompactor" with Lukens heads enabled The Buffalo-Springfield Roller Co., Springfield, Ohio, to simplify construction, save costs, and give new efficiency to huge self-propelled road rollers. Is there an idea here for you?

Imagination pays off... when you design with Lukens Heads

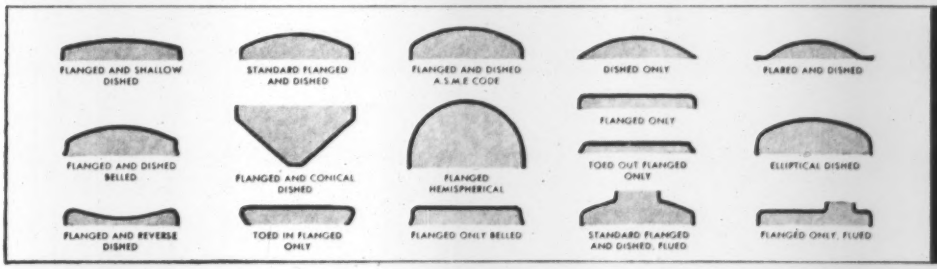
■ Take eight Lukens heads, weld them together in pairs, and what have you got?

Four brute-strength wheels with built-in ballast tanks, for one thing. Lowered costs, for another.

Buffalo-Springfield added steel pads to the wheels of their giant earth "Kompactor," achieving such operating efficiency that this one machine is able, when called upon, to combine the functions of two other machines.

Whether you build wheels, valves, chemical equipment, heavy or light machinery, imaginative use of Lukens heads may reduce design complexity, eliminate costly fabrication steps, and raise efficiency. Lukens' fifty-year experience as the leading producer of spun and pressed steel heads for many applications is at your service. Write for Catalog 929, *"Pricing and Engineering Data,"* Lukens Steel Company, Coatesville, Pa.

Lukens Offers the World's Broadest Line of Spun and Pressed Heads of Carbon, Alloy and Clad Steels



LUKENS ®

TWO SOLUTIONS TO THE CHALLENGING PROBLEMS OF

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, DETROIT, PITTSBURGH, HARTFORD, BURLINGTON

HIGH TEMPERATURE

SOUNDNESS AT 2150° F.

1 Because of their inherent soundness, metal mold centrifugally cast retorts give longer operating life at extreme temperatures. These retorts have been tested in service under the most adverse operating conditions, and field performance data prove their superiority conclusively.

Centrifugally cast stainless steel retorts are used by the New England Lime Company of Canaan, Connecticut to produce high purity magnesium metal by thermal reduction. Their retorts are operated 24 hours a day at 2150° F. under a high internal vacuum — a test only the ultimate in soundness and quality could survive.

SURFACE AT 1400° F.

2 The Selas Corporation of America, one of the nation's leading industrial furnace builders, demands a high order of quality in the stainless steel rolls used in their continuous strip annealing furnaces. Perfect roll surfaces are a "must". The slightest surface imperfection in the strip will cause rejection.

Long, trouble-free life, at extreme temperatures, is assured because of the dense, flawless roll surface made possible by the metal mold centrifugal process.

In cylindrically shaped sections, U. S. Pipe offers a wide range of sizes in electric furnace alloys for many difficult and exacting applications.

"METAL MOLD" CENTRIFUGAL CASTINGS

SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter	5" to 50"
Wall Thickness	3/8" and up
Length	Up to 16'
Type of Stainless Cast	All Standard AISI and ACI grades of ferritic and austenitic stainless plus "Special" types

Simplify control problems...

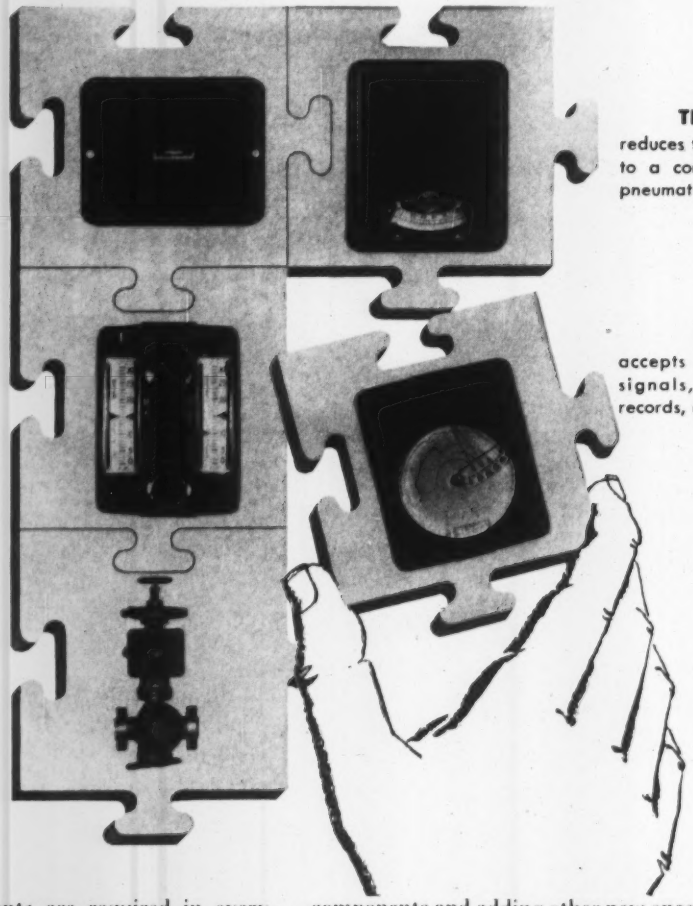
with the Bailey Building Block Method

Control problems are greatly simplified when you attack them using the Bailey Building Block Method. In a nutshell, the method consists of using standard components that fit together like building blocks. Virtually any control requirement can be handled by selecting standard components. Here are the parts you use and the functions they perform.

CONTROL RELAY
takes signals from the transmitter and computes corrective action in terms of pneumatic signals.

SELECTOR STATION
gives operator choice of hand or automatic control including set-point or bias adjustments.

POWER UNIT
is the "muscle" of the system. It performs whatever precise mechanical action is necessary to achieve control.



TRANSMITTER
reduces the measured variable to a common denominator, a pneumatic or electric signal.

RECEIVER
accepts pneumatic or electric signals, indicates and/or records, measurements.

Not all these components are required in every control system. You buy only what *your* system needs. When you change processes or add more automatic control, you can add additional standard components. Sometimes you may want to build a whole new system, re-using some of the existing components and adding other new ones. Spare parts inventory and maintenance training are reduced.

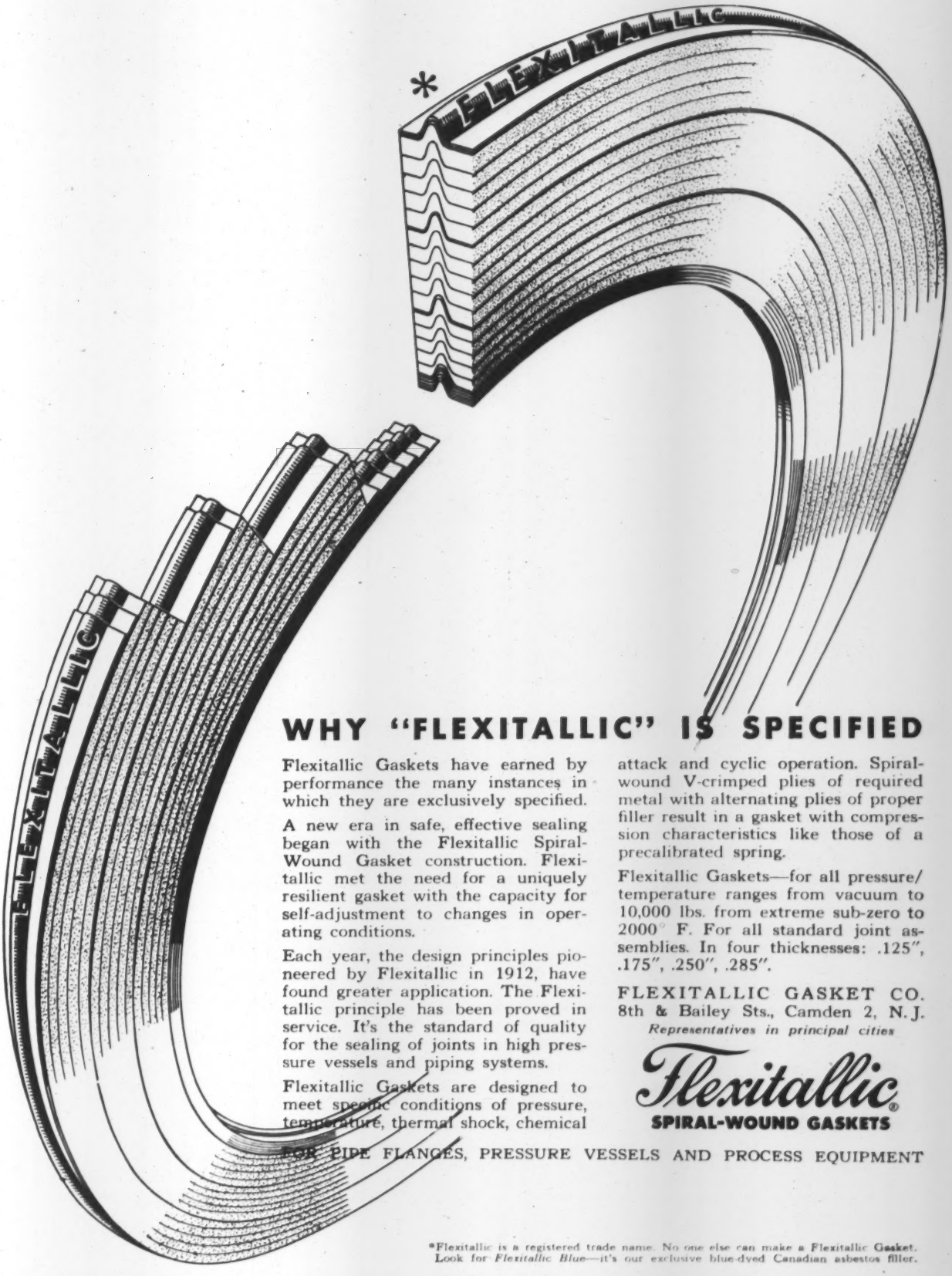
Hear the complete story of the Bailey Building Block System. Find how it can solve your control problems. See your Bailey Engineer or write for more information. G44-1

BAILEY BUILDING BLOCK METHOD

BAILEY METER COMPANY
1026 IVANHOE ROAD, CLEVELAND 10, OHIO
In Canada—Bailey Meter Company Limited, Montreal

RESULTS IN: FLEXIBILITY, SIMPLICITY, ECONOMY

BAILEY METERS



WHY "FLEXITALLIC" IS SPECIFIED

Flexitallic Gaskets have earned by performance the many instances in which they are exclusively specified.

A new era in safe, effective sealing began with the Flexitallic Spiral-Wound Gasket construction. Flexitallic met the need for a uniquely resilient gasket with the capacity for self-adjustment to changes in operating conditions.

Each year, the design principles pioneered by Flexitallic in 1912, have found greater application. The Flexitallic principle has been proved in service. It's the standard of quality for the sealing of joints in high pressure vessels and piping systems.

Flexitallic Gaskets are designed to meet specific conditions of pressure, temperature, thermal shock, chemical attack and cyclic operation. Spiral-wound V-crimped plies of required metal with alternating plies of proper filler result in a gasket with compression characteristics like those of a precalibrated spring.

Flexitallic Gaskets—for all pressure/temperature ranges from vacuum to 10,000 lbs. from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 2, N. J.
Representatives in principal cities

Flexitallic®
SPIRAL-WOUND GASKETS
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

Selective Particle Acceleration

Inlet cell vane design produces smooth, even deflection and controlled acceleration of air stream. Smaller lighter dust particles pick up speed quickly, larger particles accelerate more slowly. Both attain enough velocity for good separation, but not enough to cause erosion damage. This is the Hagan principle of Selective Particle Acceleration.

Installation of fully pre-assembled Hagan Dust Collector

Minimum erosion, fast installation...

HAGAN MECHANICAL DUST COLLECTOR

Fast installation is one of the features of the new Hagan Dust Collector. Recently a collector for a 75,000 lb/hr boiler was erected in less than fourteen hours. With the duct work connected up, it was ready to go.

The Hagan vaned-nozzle inlet design has practically eliminated tube erosion and collection efficiencies are raised, because of high effectiveness in the 1 to 10 micron range. Check these cost and trouble-saving features:

- Tube erosion virtually eliminated. Hagan Dust Collectors are *guaranteed* against tube failure due to erosion *for two full years.*
- Pressure drop 20% lower than conventional multiple tube collectors based on same efficiency.
- Hexagon shaped tops—This honeycomb shape permits close tube packing, eliminates dust trapping and clogging.
- Easy maintenance—Ease of access to all parts makes the Hagan Dust Collector easy to inspect.
- Lower overall height requirements.

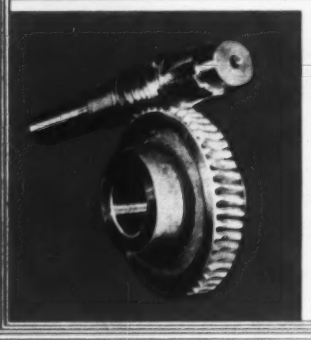
Add to these the fact that the Hagan Dust Collector's efficiency easily meets the most rigid existing code requirements for coal fired boilers for any city in the United States.

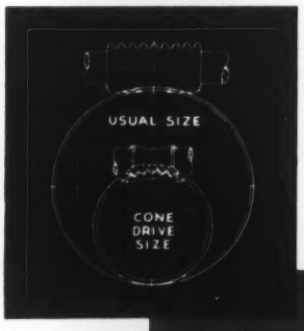
Write for specifications, or a Hagan engineer will be glad to discuss your particular requirements.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES

for concentrated power





. . . CONE-DRIVE gearing has no equal.

You can pass an amazing amount of power through a set of Cone-Drive gears.

Want to cut product size? Cone-Drive will give you a more compact gear train with reserve load capacity.

Want to boost power output and hold size? That's easy with Cone-Drive gears. They'll carry two, three, and four times the load of cylindrical worm gearing.

Why? In Cone-Drive gears, the load isn't concentrated on a small area per tooth or on just one or two teeth at a time. Cone-Drive's exclusive double-enveloping principle distributes the load over a lot of teeth and over more area on each tooth.

It cuts the unit loading the same way a pair of snowshoes supports a heavy man.

Ask for Bulletin CD-400 for complete details.

CONE-DRIVE GEARS
Division Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
7171 E. McNichols Road • Detroit 13, Michigan

Close up of Acipco steel tubes used as hydraulic cylinders and rams in the new Dempster-Balester scrap metal press.

DEMPSTER BALESTER

New Dempster-Balester "750" features the Auxiliary-Compression Door and Skip-Pan Loader. New, longer charging box handles scrap as large as a complete auto body.

ACIPCO

Centrifugally Spun

STEEL TUBES

Selected for Newly Developed Press

Dempster Brothers, Inc., of Knoxville, Tennessee, is one of the country's leading manufacturers of baling equipment. They also manufacture equipment in the famous Dempster-Dumpster System of materials handling.

When Dempster Brothers' engineers required powerful hydraulic cylinders for their new "750" Dempster-Balester, they called on Acipco. Working with Dempster Brothers' creative engineering staff, Acipco supplied the two main hydraulic cylinders, completely fabricated and assembled, for this new, more economical press.

The Dempster-Balester main cylinders are examples of the extra advantages you get when you specify Acipco centrifugally spun steel tubes for your application. In addition to getting high quality tubes with the exact physical, metallurgical and chemical properties your application requires, you get the benefits of expert technical assistance and Acipco's combination of complete facilities and manufacturing competence.

If you manufacture or design products requiring tubular steel, your nearest Acipco distributor will be glad to supply information about Acipco steel tube applications in your field.

Hydraulic cylinders fabricated of Acipco steel tubes ready for shipment.

SIZE RANGE: Lengths up to 16′ — longer lengths by welding tubes together. OD's from 2.25″ to 50″; wall thicknesses from .25″ to 4″

ANALYSES: All alloy grades in steel and cast iron, including heat and corrosion resistant stainless steels; plain carbon grades and special non-standard analyses.

AMERICAN CAST IRON PIPE CO.

ACIPCO

Special Products Division

BIRMINGHAM 2, ALABAMA

DISTRIBUTORS

Austin-Hastings Co., Inc.
226 Binney St.
Cambridge 42, Mass.

Peter A. Frasse and Co., Inc.
17 Grand St.
New York 13, N. Y.

Lyman Tube & Bearings, Ltd.
920 Ste. Sophie Lane
Montreal 3, Canada

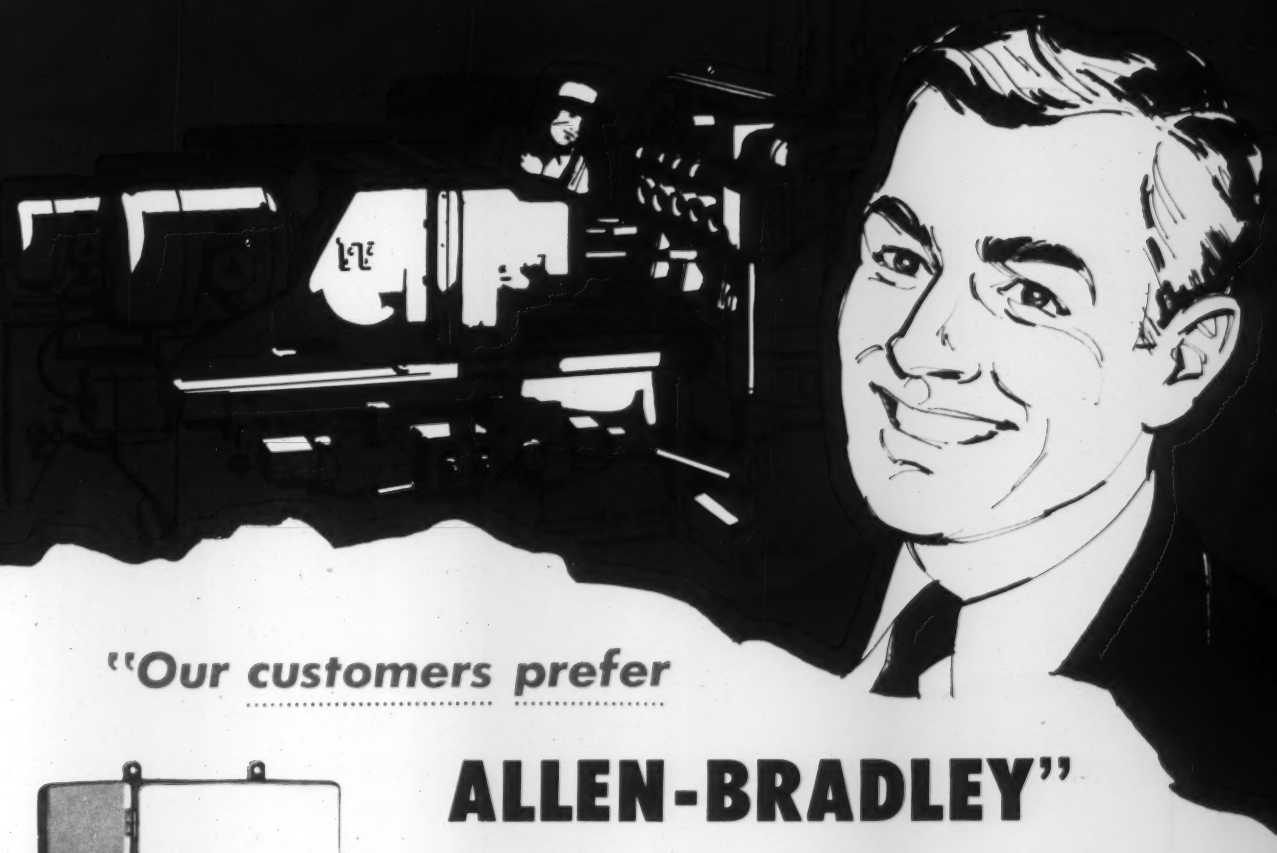
Vinson Steel & Aluminum Co.
4606 Singleton Blvd.
Dallas 7, Texas

J. M. Tull Metal & Supply Co.
285 Marietta St., N.W.
Atlanta, Ga.

C. A. Roberts Company
2401 Twenty-fifth Avenue
Franklin Park, Ill.

Strong, Carlisle & Hammond Co.
1392 W. Third St.
Cleveland 13, Ohio

Ducommun Metals & Supply Co.
4890 So. Alameda St.
Los Angeles 54, Calif.

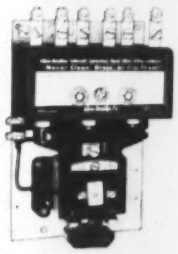


"Our customers prefer

ALLEN-BRADLEY"

Bulletin 709
Solenoid Starters—
available in 8 sizes
up to 300 hp, 220 v;
600 hp, 440-550 v.

A-B Quality



Bulletin 702
Solenoid Contactor
Size 3

Bulletin 702
Solenoid Contactor
Size 1

Bulletin 700
Solenoid Relay

Bulletin 800T
Oiltight Push Button

Bulletin 800T
Oiltight Selector Switch

Among leading manufacturers of machine tools, Allen-Bradley Quality motor starters are the favorite—as shown by many independent preference studies. Having the Allen-Bradley Quality trademark appear on your equipment means automatic customer acceptance.

The "simple design" of Allen-Bradley motor control . . . with only *one* moving part . . . guarantees reliable operation. The double break, silver alloy contacts—used in all Allen-Bradley controls—are always in perfect operating condition. Even inspection time—let alone maintenance time—is saved.

No matter what your control requirements may be, they can be met with standard components listed in the Allen-Bradley Handy Catalog . . . Allen-Bradley control specialists can help you with your control problems. *Standardize* on Allen-Bradley Quality motor control . . . add this sales asset to your production machines!

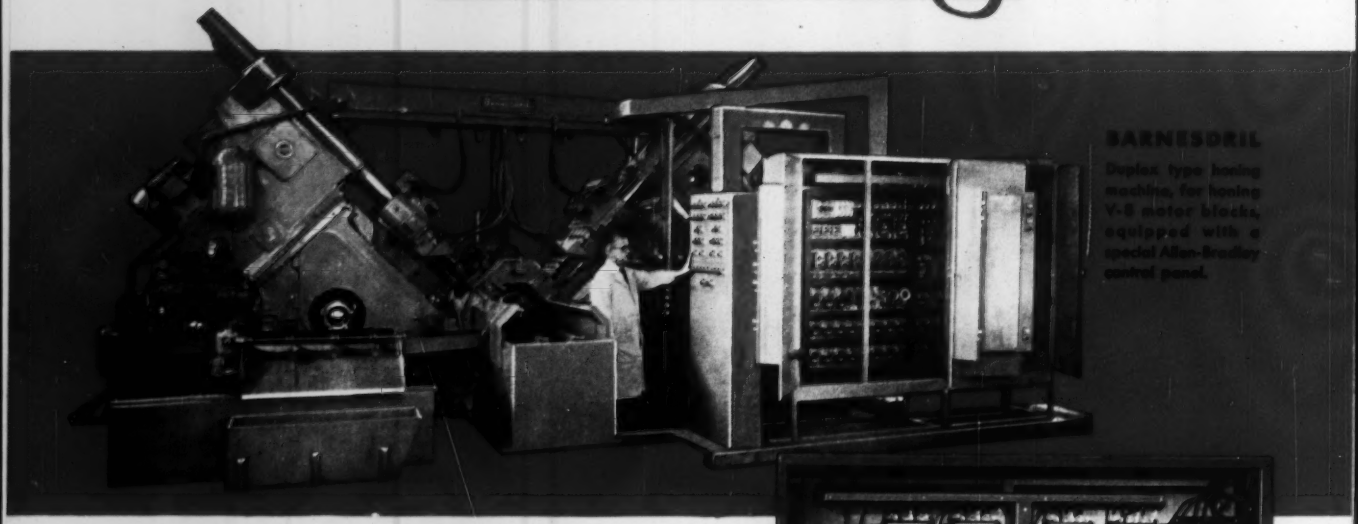
ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

5-57-R

for reliability... plus consistent operation

SPECIFY Allen-Bradley

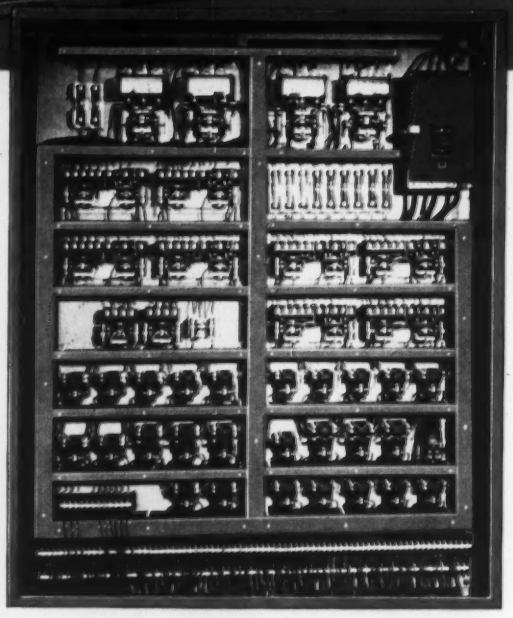


The motor controls on your automatic machines must be reliable when the machines are new . . . and remain reliable when the machines are old. When the sequence of operations is short, the controls must be instantaneous and consistent in their operation . . . or production has to be slowed down to the maximum variation in time of contactor operation. Sluggishness of a single component . . . even for a split second . . . may mean costly repairs and work spoilage.

Reliability is an integral part of all A-B motor controls. The simple solenoid design . . . with only one moving part . . . assures millions of trouble free operations. The double break, silver alloy contacts never need service attention.

Let Allen-Bradley help you with your special control problems. As you know, "quality" and "cheap" are two "teams" never in the same league.

Please send for the new Allen-Bradley Handy Catalog.



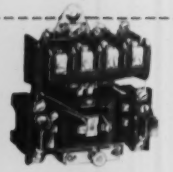
Motor control panel for a Barnesdril honing machine made from standard Allen-Bradley control units listed in the Allen-Bradley Handy Catalog.

5-57-R

A-B Quality

BULLETIN 849
"On-Delay"
Pneumatic Timer

BULLETIN 802T
Adjustable Lever
Oiltight Limit Switch



BULLETIN 709
Automatic
Solenoid Starter

BULLETIN 700
Universal Type
Solenoid Relay

BULLETIN 800T
Oiltight Push Button
Station

ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada—Allen-Bradley Canada Ltd., Galt, Ont.

Largest bronze centrifugal casting ever made, 54¼" O.D. x 49½" I.D. x 346½" long. Charge weight—72,300 pounds.

At Sandusky,

GIANTS ARE ROUTINE...

Small wonder. We serve giant industries . . . paper-making, shipbuilding, metalworking, atomic energy, petro-chemical, and others . . . with centrifugally cast cylinders and tubular parts, many of which can't be made by any other process to the exacting standards required.

It's the 47 years of specialized experience coupled with unequalled manufacturing facilities . . . that makes it routine for our engineers and production teams to cast and machine *cylinders from 7" to 54" O.D. and up to 33 feet in length* . . . in a wide range of alloys meeting special performance requirements.

Do you need a giant cylindrical form . . . or a small one . . . machined to exact working dimensions? Send us your specifications; we'll reply promptly.

Sandusky Centrifugal Castings offer you 4 important advantages:

1. ***SUPERIOR MECHANICAL PROPERTIES*** —to meet exacting design requirements
2. ***UNIFORM SOUNDNESS***—free from harmful inclusions and porosity
3. ***HIGHEST QUALITY***—to insure long, dependable, trouble-free service
4. ***JOB-READY CASTINGS***—machined to your exact specifications, eliminate extra costs from rejects, down-time, loss of production

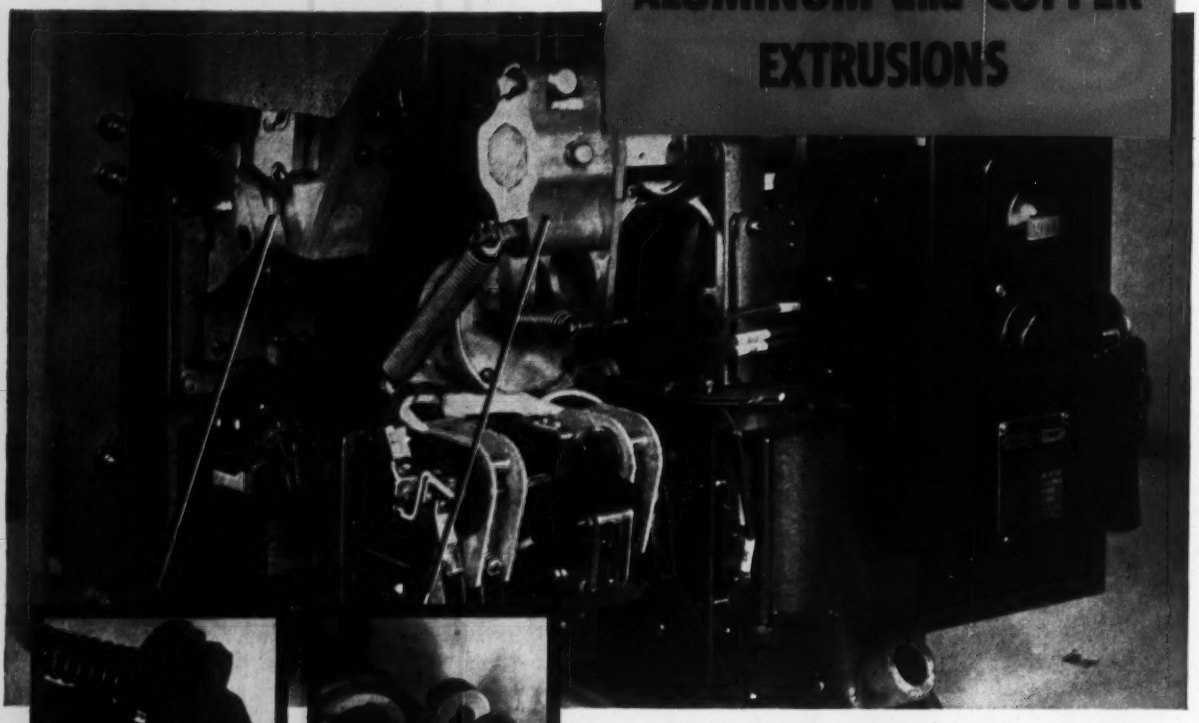
CENTRIFUGAL CASTINGS

Sandusky Foundry & Machine Company

SANDUSKY, OHIO • Stainless, Carbon, Low Alloy Steels—Full Range Copper Base, Nickel Base Alloys

REVERE
ALUMINUM and COPPER EXTRUSIONS

I-T-E CIRCUIT BREAKER—KD (3,000 amp. rating) showing progressive assembly with Revere Copper and Aluminum Extrusions in place. I-T-E Circuit Breaker—KE is same type with 4,000 amp. rating.



COPPER
for conductivity

ALUMINUM
for economy

—form a Money-Saving team in latest

I-T-E CIRCUIT BREAKERS

Revere T. A. Service an Important Factor in Ultimate Design of Parts

The larger of the two extruded and drawn copper shapes shown at extreme left started out on the drawing board as two pieces. It was thought that a single shape of this size could not be made satisfactorily. At this point, I-T-E Engineers got together with Revere's T. A. (Technical Advisory) Service and threshed things over. The final result is the one-piece extrusion shown and a reduction in machining time.

Aluminum was selected for the other extrusion shown because I-T-E found that it cost less per pound of metal and had a higher strength ratio when compared to a casting. Also, space was a factor. In all, Revere supplies 5 copper and 2 aluminum extrusions for KD and KE type I-T-E Circuit Breakers. All were designed to fit specific requirements of I-T-E Engineers. Where it could be used satisfactorily, aluminum was applied because of economy, while current carrying members called for copper.

This is still another example of Revere supplying the metal that will do the best job and with the greatest economy . . . be it aluminum, copper or any one of their alloys. So, with new things happening all the time in non-ferrous metals it can pay you to keep in close touch with Revere.

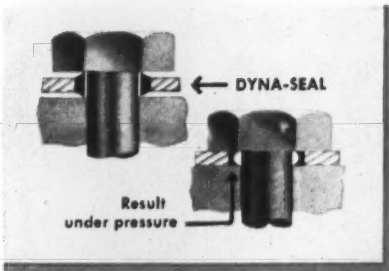
COPPER ★ BRASS ★ 18 01 ★ REVERE ★ ALUMINUM

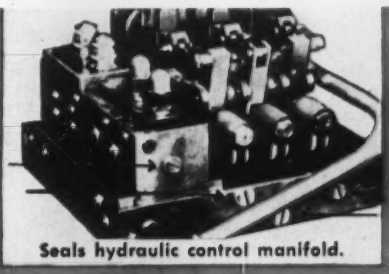
REVERE COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

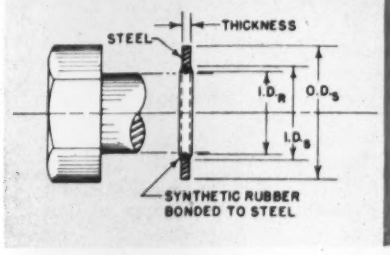
Problem A simple, low cost solution to a face-to-face sealing problem

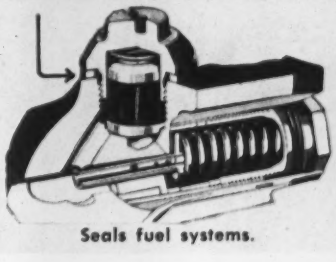
Solution Precision Dyna-seal®




Seals hydraulic control manifold.

Seals relief valve.




Seals fuel systems.

Seals aircraft fittings.

Easy-to-handle one piece seal of rubber bonded to a steel washer.

No special machining required.
Reduces assembly costs.
Positive sealing up to 10,000 P.S.I.
Vibration proof, lock washer action.
Reduces bolting torque.
Reusable—cuts maintenance.

Available in-stock sizes for No. 5 screw to 1¼" bolt or from ⅛" to 1¼".

Let a Precision engineer demonstrate the Dyna-seal cost and labor saving advantages to you. Write today!

PRECISION PART NO.	BOLT SIZE (MAX. O.D.)	I.D.S ±.003	O.D.S ±.003	I.D.R ±.000, .004	THICKNESS ±.0025
110-5	.125	.195	.315	.145	.041
110-6	.138	.208	.328	.158	.041
110-8	.164	.234	.364	.184	.041
110-3/16	.190	.281	.422	.220	.054
110-7/32	.216	.307	.453	.246	.054
110-1/4	.250	.341	.516	.280	.054
110-5/16	.312	.403	.594	.342	.054
110-3/8	.375	.466	.687	.405	.054
110-7/16	.437	.528	.766	.467	.075
110-1/2	.500	.601	.875	.540	.075
110-9/16	.562	.663	.969	.602	.075
110-5/8	.625	.726	1.062	.665	.075
110-11/16	.687	.788	1.156	.727	.090
110-3/4	.750	.865	1.266	.800	.090
110-13/16	.812	.927	1.359	.862	.090
110-7/8	.875	.990	1.453	.925	.090
110-15/16	.937	1.052	1.531	.987	.090
110-1	1.000	1.135	1.656	1.050	.090
110-1 1/8	1.125	1.260	1.844	1.175	.090
110-1 1/4	1.250	1.385	2.016	1.300	.134

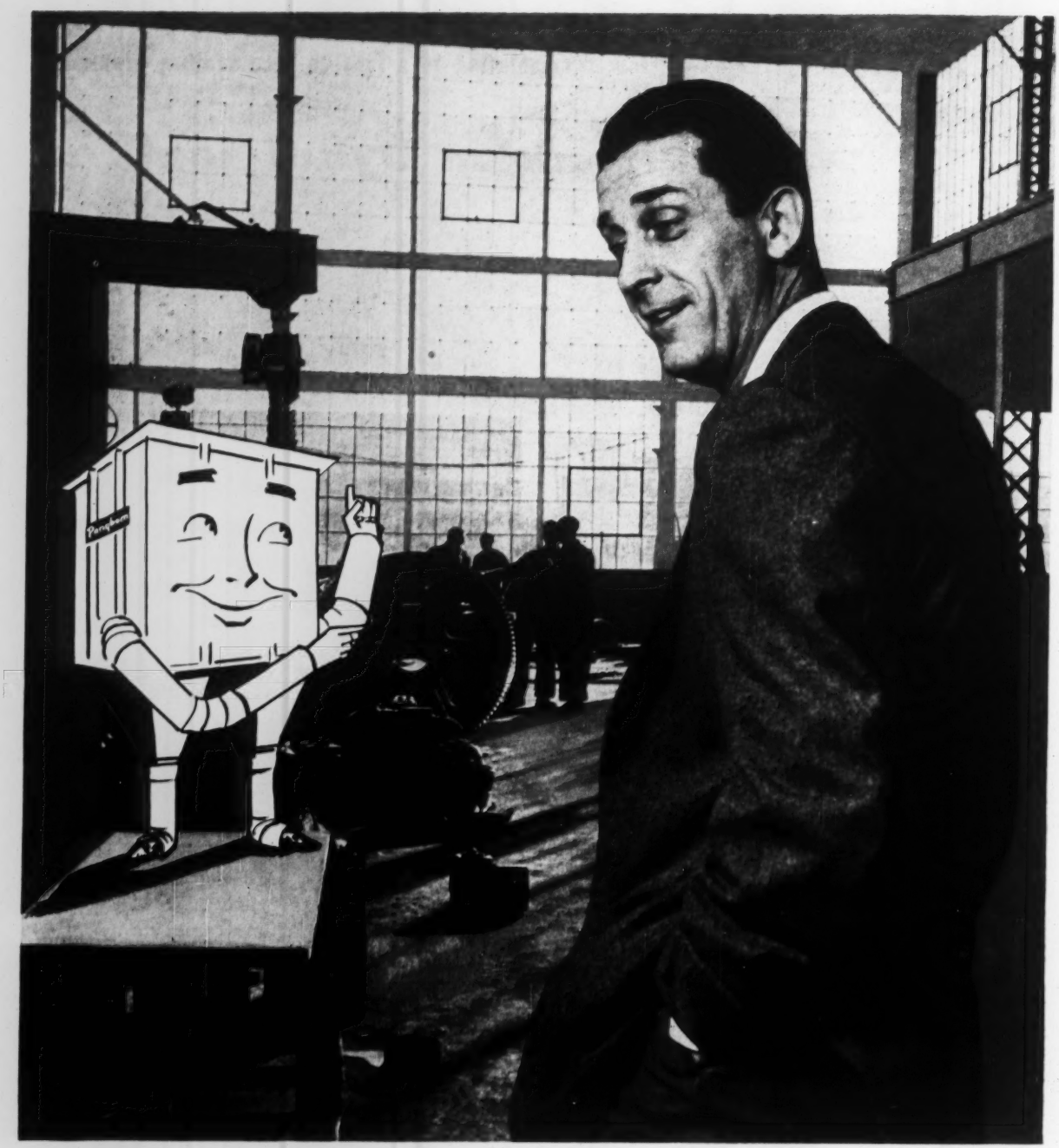
Write for your free copy of the Precision catalog on Dyna-seals.

Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

Dept. 9, Oakridge Drive, Dayton 7, Ohio

Canadian plant at: Ste. Thèrése de Blainville, Québec



"You're kidding! Cut housekeeping costs 20%?"

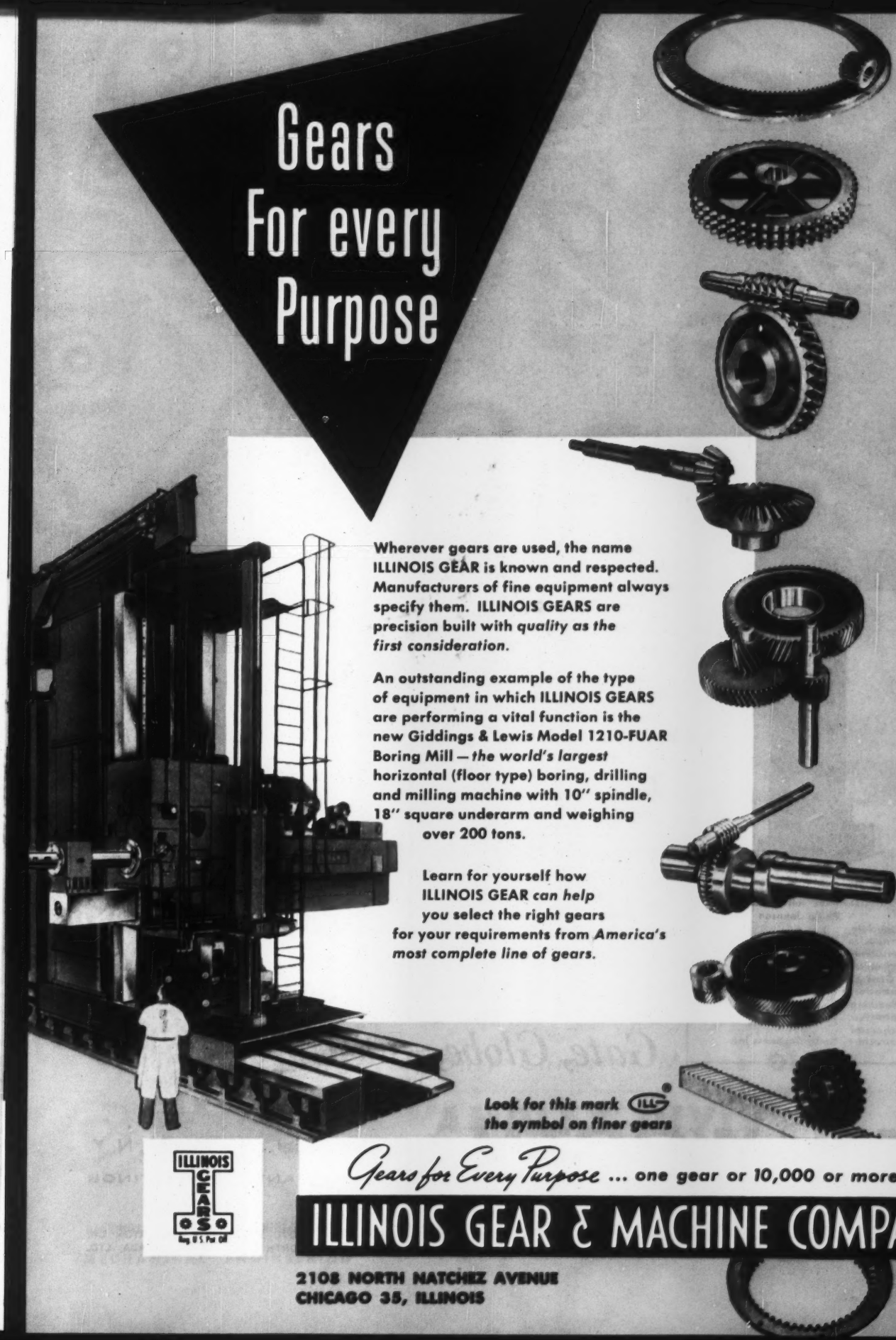
You heard right! Many firms have been getting 20% lower housekeeping costs after installing Pangborn Dust Control in their plants. That's because Pangborn Collectors trap dust controlled at the source . . . won't permit uncontrolled dust to settle on walls, floors, working surfaces. Of course, we can't promise *your* housekeeping costs will drop as much as 20%. But less painting, sweeping, washing can cut your overall maintenance costs 5%, 10%, 15% or even more.

What's more, Pangborn gives you other benefits of longer machinery life, higher employee efficiency, extra profits from any salvage value and better employee and community relations. And Pangborn offers a complete line of dust collectors for all jobs.

Discover how you can profit from Pangborn Dust Control! Write for Bulletin 922 to PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Dust Control and Blast Cleaning Equipment.*

Pangborn CONTROLS DUST

Gears For every Purpose



Wherever gears are used, the name ILLINOIS GEAR is known and respected. Manufacturers of fine equipment always specify them. ILLINOIS GEARS are precision built with *quality as the first consideration.*

An outstanding example of the type of equipment in which ILLINOIS GEARS are performing a vital function is the new Giddings & Lewis Model 1210-FUAR Boring Mill — *the world's largest* horizontal (floor type) boring, drilling and milling machine with 10" spindle, 18" square underarm and weighing over 200 tons.

Learn for yourself how ILLINOIS GEAR *can help you* select the right gears for your requirements from *America's most complete line of gears.*

Look for this mark ILG® *the symbol on finer gears*

ILLINOIS GEARS

Gears for Every Purpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

2108 NORTH NATCHEZ AVENUE
CHICAGO 35, ILLINOIS

Owner:	House of Seagram, Inc.
Architects:	Mies van der Rohe & Philip Johnson
Associate Architects:	Kahn & Jacobs
Consulting Engineers:	Jaros Baum & Bolles
General Contractor:	George A. Fuller Company
Plumbing Contractor:	Eugene Duklauer Inc.
Mechanical Contractor:	Kerby Saunders Inc.

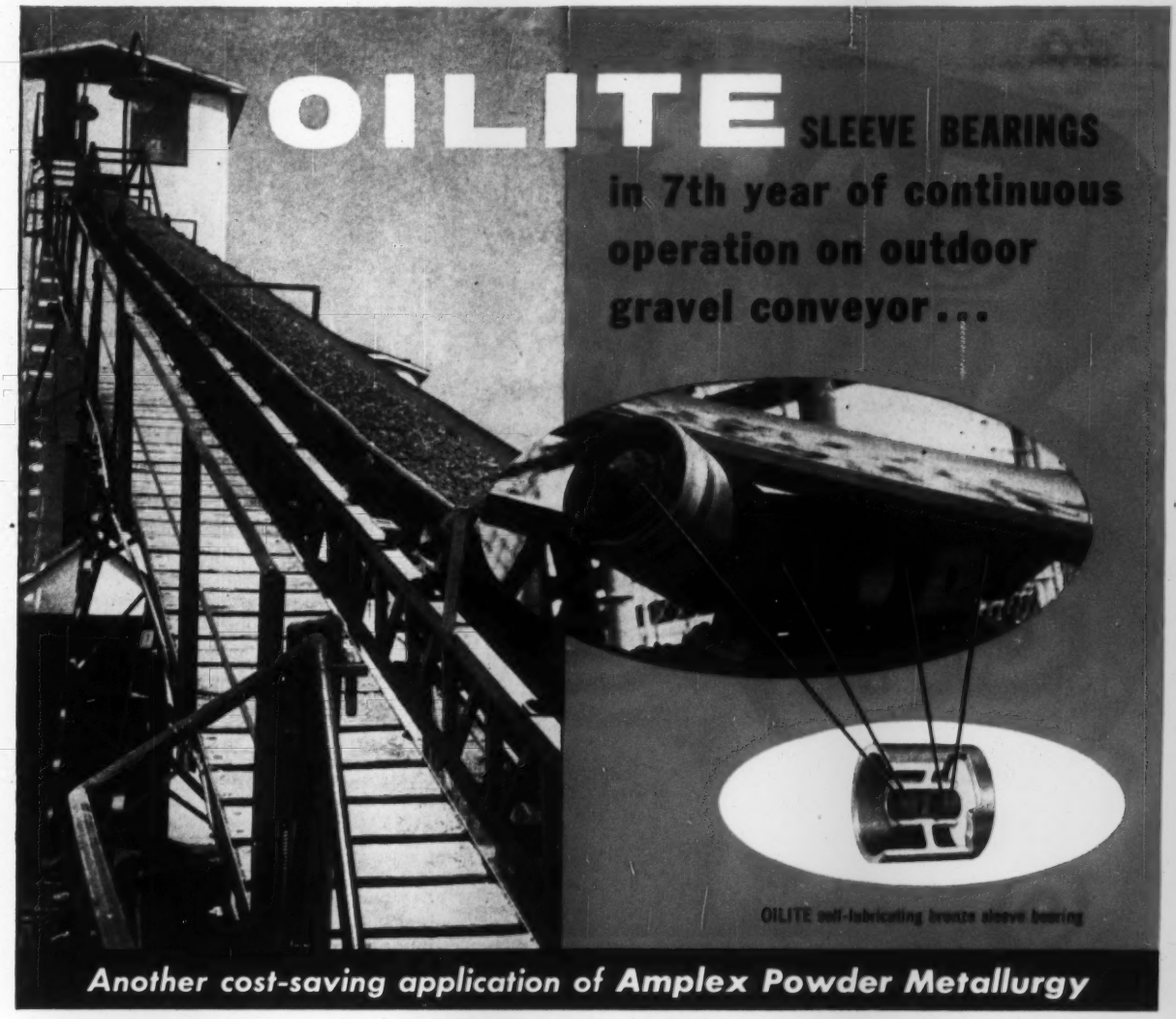
"In the new Seagram building it's 100% Walworth Gate, Globe, and Check Valves"

WALWORTH 60 East 42nd Street, New York 17, N. Y.

COMPLETE LINES OF STEEL, IRON, AND BRONZE VALVES AND PIPE FITTINGS

Distributors in principal centers throughout the world

Walworth Subsidiaries: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. M&H VALVE & FITTING CO. • SOUTHWEST FABRICATING AND WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.


OILITE SLEEVE BEARINGS
in 7th year of continuous operation on outdoor gravel conveyor...
OILITE self-lubricating bronze sleeve bearing

Another cost-saving application of Amplex Powder Metallurgy

No seals protect these OILITE bearings from sand, gravel, grit. On the two center rollers, no additional lubrication is possible. Yet this OILITE-equipped outdoor conveyor has been in continuous operation under extreme weather conditions for seven years—*without replacing one OILITE bearing.*

That's some record! J. Cooke (Concrete Blocks) Ltd., of Aldershot, Ontario, one of Canada's largest producers of concrete blocks, operating twenty of these sand and gravel conveyors, has proved the long wearing, money saving qualities of OILITE bearings.

No wonder all twenty conveyors are 100% OILITE equipped. The company says, "We wouldn't use any other kind."

What interests you? Longer product life—greater efficiency—lower cost? All three? Maybe Amplex has the answer.

Write for detailed information about Amplex powder metal components—OILITE Bearings, Parts, Filters. Or call your nearest engineering representative listed in the yellow pages under "Bearings—OILITE."

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MARSH

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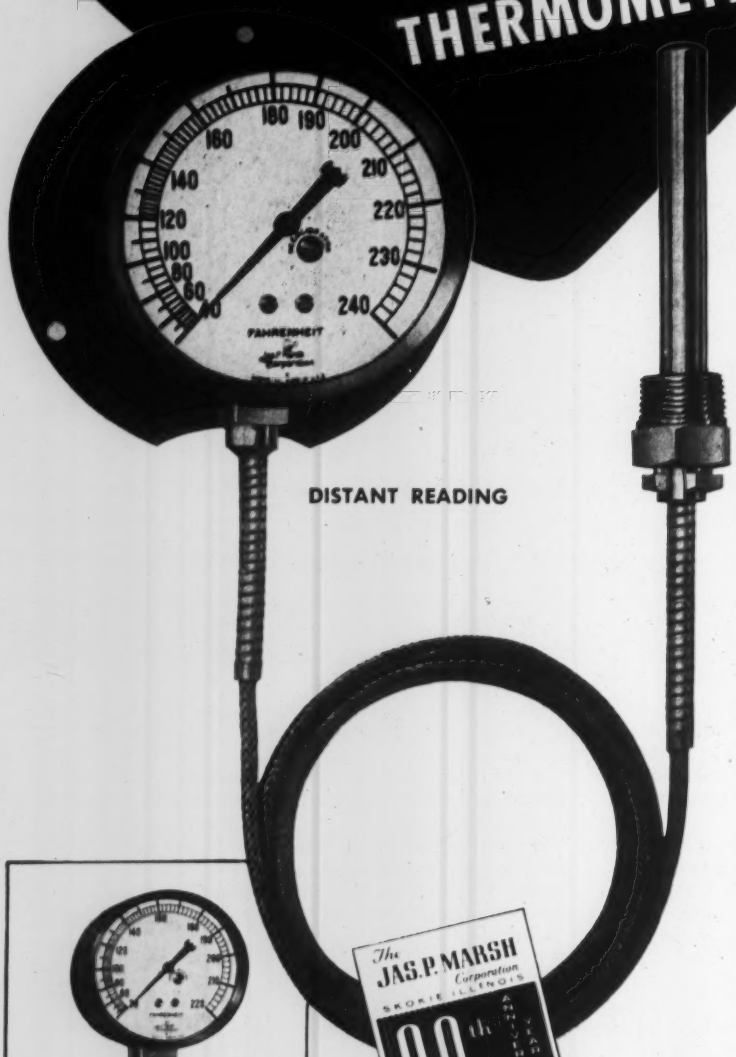

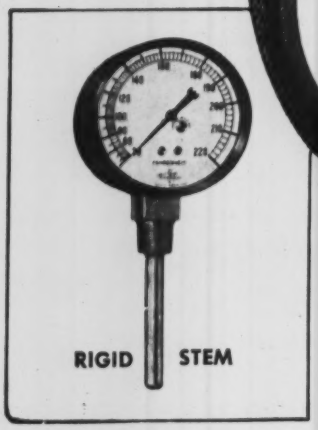

Wider range of application

...TIME PROVED MARSH QUALITY

The best of all we have learned in 90 years of instrument making has gone into Marsh Dial Thermometers. They are the versatile, vapor tension type—the type that covers the widest range of needs . . . brought to the highest stage of development in the broad Marsh line.

Ambient temperatures have no effect on dial readings of Marsh Vapor Tension Thermometers. Therefore no compensating adjustments are ever needed. The distant reading type will give highly accurate readings even when located far from the point of temperature measurement. All thermometers have the famous Marsh "Recalibrator"—quickest and best way to keep an instrument accurate.

The Marsh line is the most complete line: Rigid stem thermometers are available in dial sizes of 2½", 3½" and 4½"; distant reading types in sizes of 2", 2½", 3½", 6", 8". All are made in 12 different ranges reading as low as —40° F. and as high as 350° F., and in scale lengths to cover all services. An outstanding contribution to their practical application is the wide range of bulb types available to suit all services. Cases are available in patterns for all mountings and in black steel, polished brass, nickel and chromium plate.

Catalog covers all details — types, ranges, case patterns, dimensions, bulb variations, dial graduations. Write for it.

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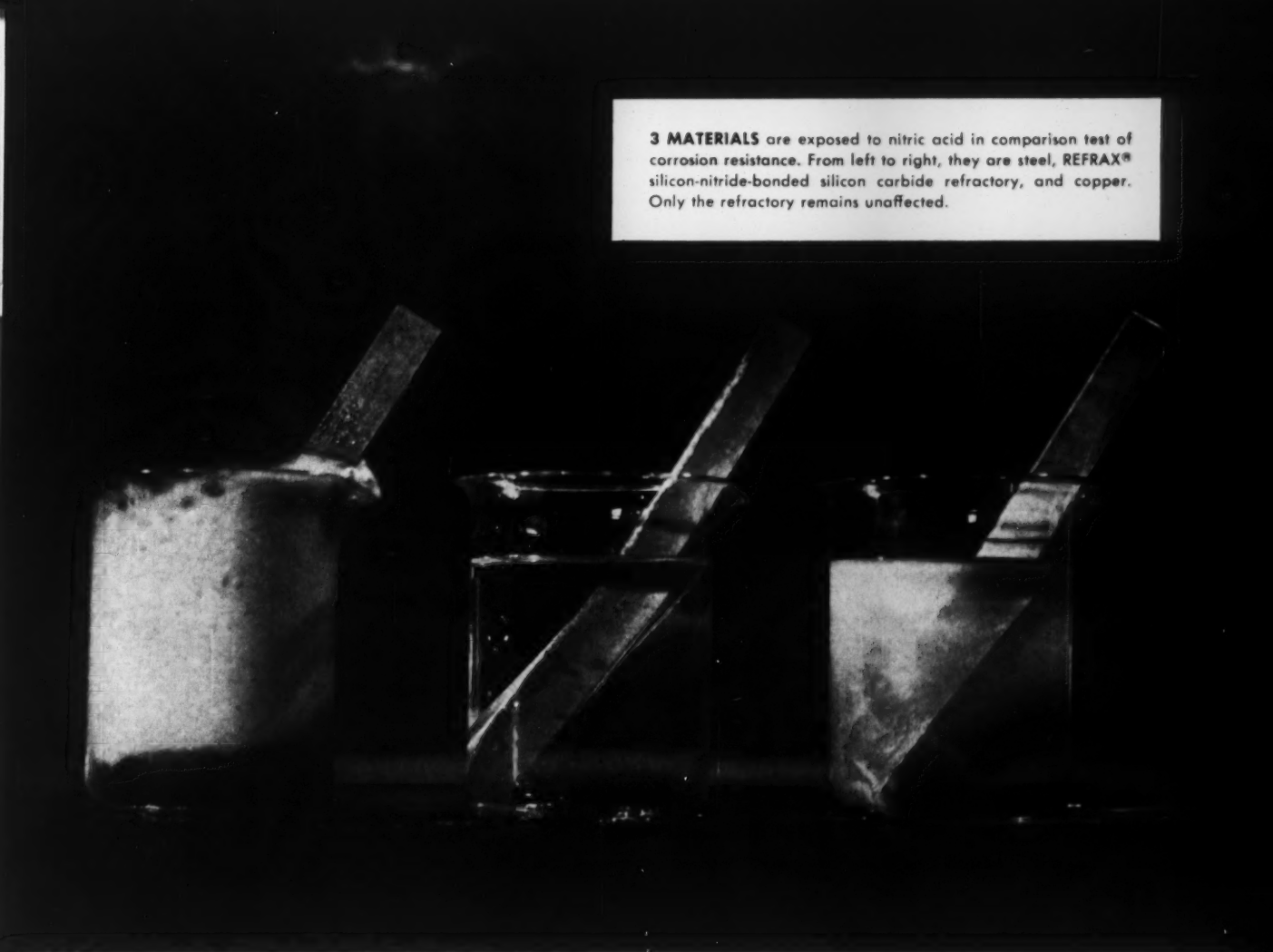

3 MATERIALS are exposed to nitric acid in comparison test of corrosion resistance. From left to right, they are steel, **REFRAX®** silicon-nitride-bonded silicon carbide refractory, and copper. Only the refractory remains unaffected.

Refractories for outstanding **corrosion resistance**

Wherever the possibility of chemical attack exists, it pays to consider refractories as materials of construction. The picture shows why. In numerous corrosive applications, CARBORUNDUM'S refractories are proving superior to other materials. They resist many highly basic substances as well as acids, acid slags and fluxes.

Typical applications are: linings in controlled atmosphere furnaces, pumps and pump parts handling molten aluminum, nozzles spraying corrosive *and* abrasive liquids, linings in muriatic acid furnaces, retorts for reducing and refining zinc ores, linings for glass tanks, etc.

But seldom is a refractory called upon to provide corrosion resistance alone. It may be required to transmit heat rapidly, resist thermal shock cracking, withstand abrasion, carry heavy loads, retain initial purity . . . whether at low or extremely high temperatures.

These properties are but a few of those found in super refractories pioneered by CARBORUNDUM. Among them, you are almost certain to find answers to your material selection problems. For help, fill in and mail this coupon today.

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The Carborundum Company, Perth Amboy, N. J., Dept. 167

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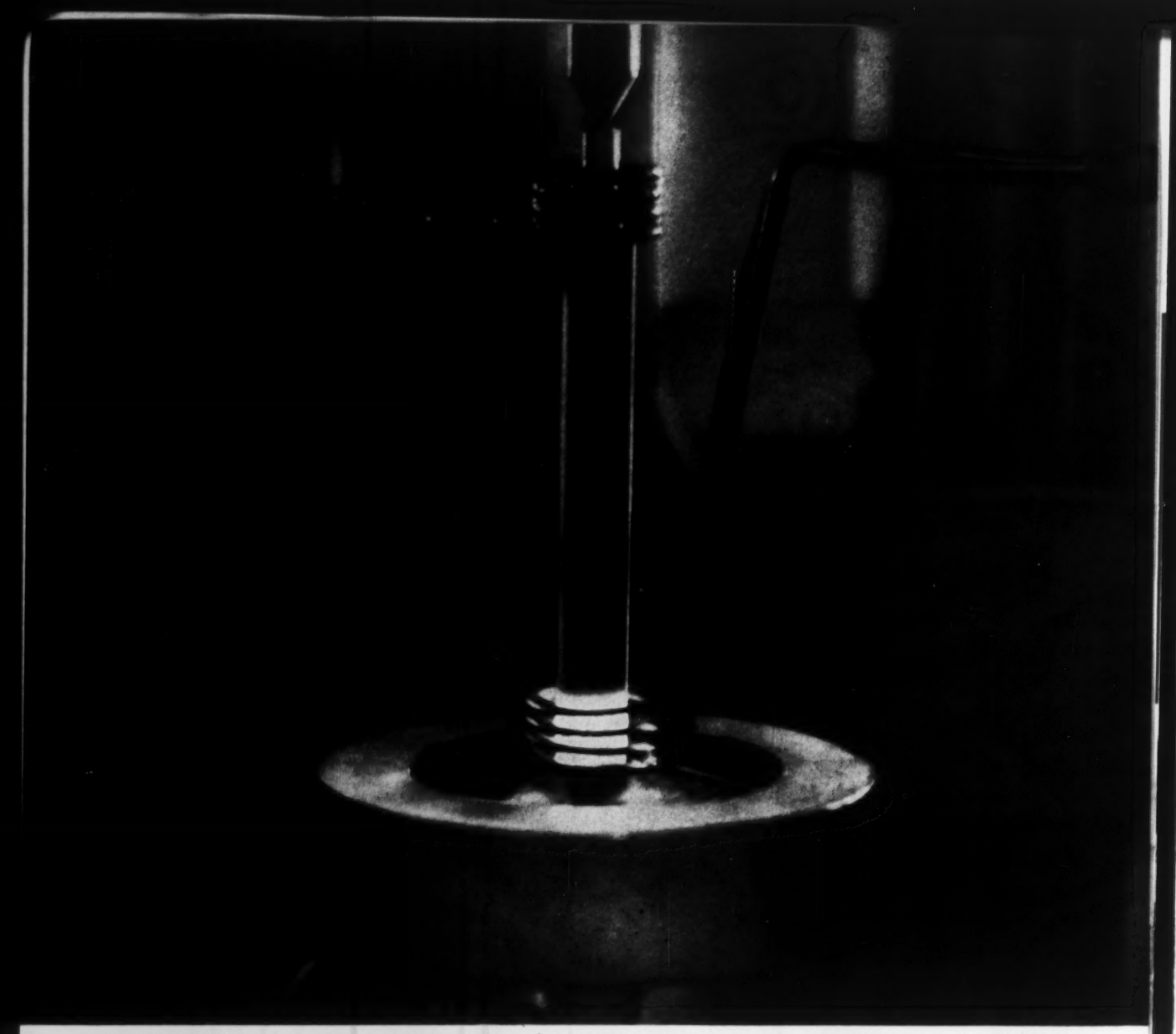

Ketos shaft being induction hardened to Rockwell 55-56, while ends remain soft for final machining. Photographed at Control Instrument Co., Inc., Brooklyn, N. Y.

KETOS has wide hardening range with minimum volume change...

Ketos is a low priced alloy tool steel that can be hardened from low temperatures with practically no volume change. It has deep hardening qualities, and a fine grained structure, that make it desirable for many production parts.

That's why nondeforming Ketos is well suited not only for most tool steel applications such as gauges, dies, and taps but also for close-tolerance, wear-resistant parts like the actuator bar shown in the induction heating unit above. The thin contact edges of this particular part withstood a "life test" of over 4-million high speed blows. No other steel tested lasted more than 1-million cycles before it chipped and failed.

If Ketos sounds like the steel you should be using, call your nearby Crucible warehouse. Stocks of Ketos and dozens of other special tool steels are large, delivery fast. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

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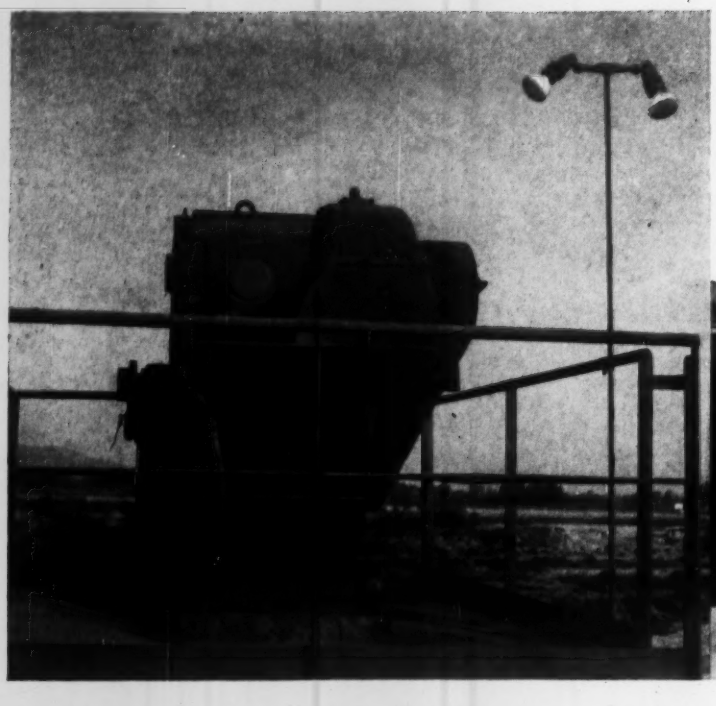
MIXING NEARLY 2 MILLION TONS OF ASPHALT YEARLY . . .

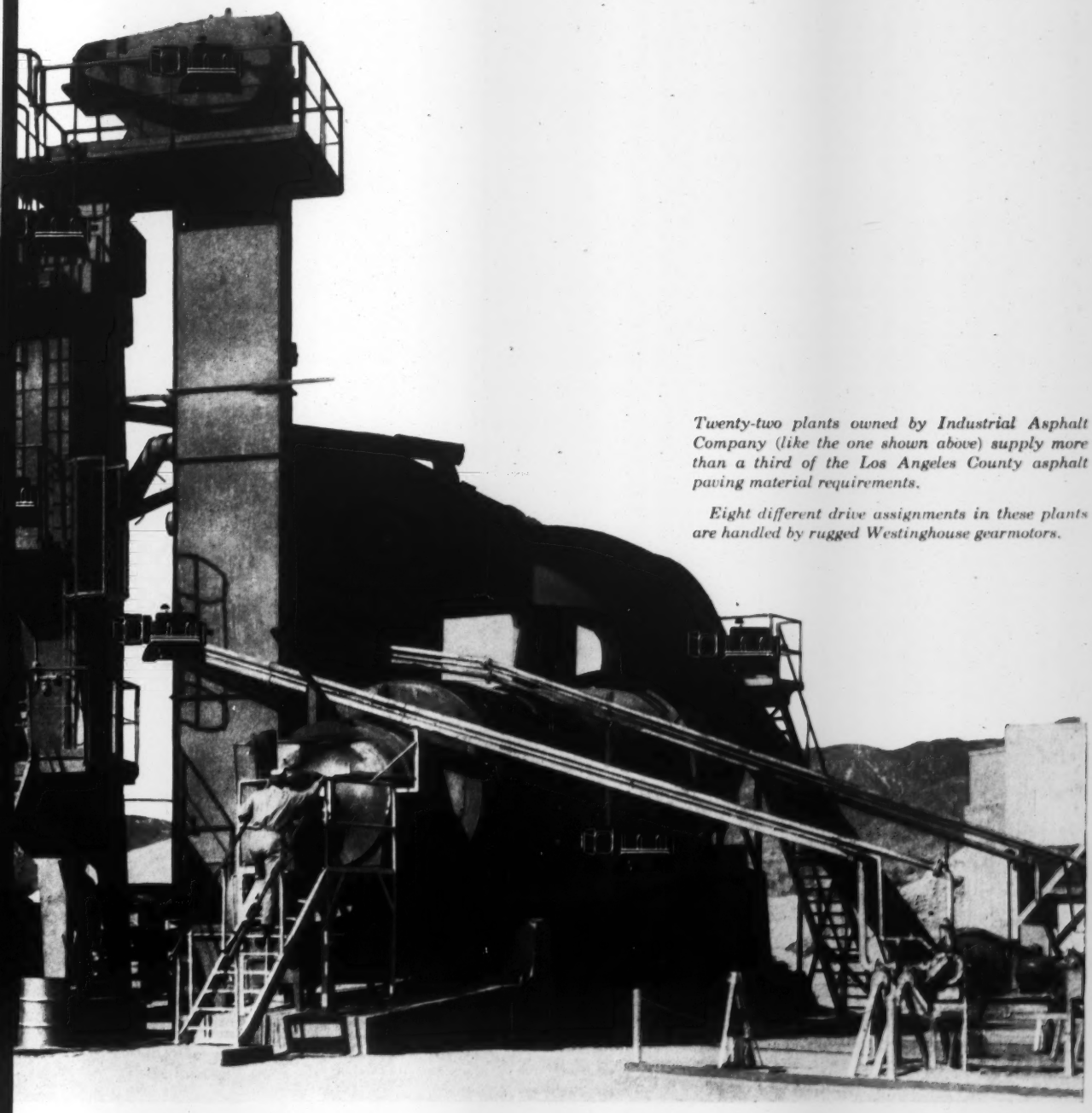
WESTINGHOUSE GEARMOTORS SET 15-YEAR DEPENDABILITY RECORD



Mounted on top of a 36-foot high aggregate elevator, this Westinghouse gearmotor moves 6600 lbs. of rock a minute from the ground to the vibrating screen. There has not been one failure in 15 years in either motor or gearing despite repeated high torque requirements and adverse weather conditions.

"We have used Westinghouse gearmotors in our plants for more than 15 years," reports E. J. Woodward, Chief Engineer of Industrial Asphalt, Los Angeles. "Gearmotors driving the hot elevators take the toughest strain. Most of these units have been operating 15 years without replacement or addition of new bearings or motor armature. These drives take occasional overloads safely, too. For example, we've increased output from 230 to 283 tons per hour without a failure."

"As a manufacturer of these asphalt plants, we demand absolute dependability in all components,"



Twenty-two plants owned by Industrial Asphalt Company (like the one shown above) supply more than a third of the Los Angeles County asphalt paving material requirements.

Eight different drive assignments in these plants are handled by rugged Westinghouse gearmotors.

remarked M. B. Preeman, of Standard Steel Corporation. "Dependable service is the primary reason for using Westinghouse gearmotors in Standard Steel asphalt plants."

Here's another example of the type of service you can expect from Westinghouse gearmotors and speed reducers. You can get immediate delivery in horsepower ratings from 1 to 100; reduction ratios to 58.3:1. Call your local Westinghouse sales engineer, or write, Westinghouse Electric Corporation, Gearing Division, 200 McCandless Avenue, Pittsburgh, Pennsylvania. J-07355

YOU CAN BE SURE...IF IT'S

Westinghouse

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

AI develops reactors for largest power plants and smallest research labs

A wide selection of nuclear reactors, ranging in size from a 75-megawatt nuclear power plant to generate electricity, to a 5-watt laboratory instrument, have already been completed, or are at present under construction by ATOMICS INTERNATIONAL.

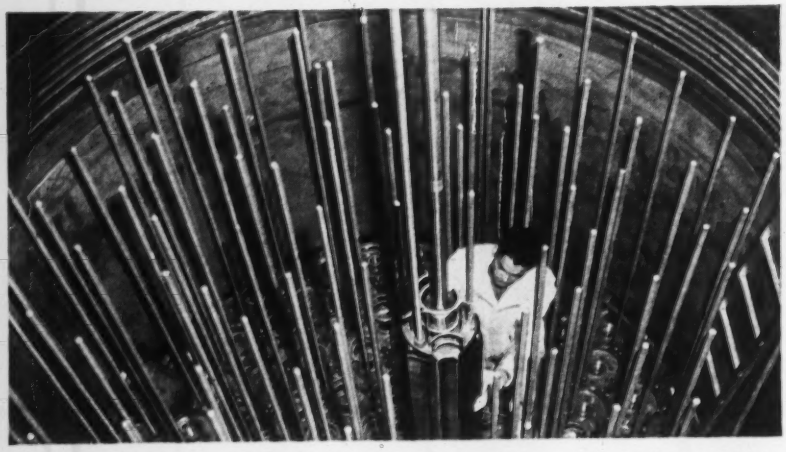
The Sodium Reactor Experiment, part of the Atomic Energy Commission's program to develop economical nuclear power, now undergoing tests in the Santa Susana Mountains near Los Angeles, will have an output of 20 thermal mw and will generate about 6.5 mw of electric power. It is the prototype of a full-scale sodium graphite reactor design, which will have a power output of 75 to 125 mw. ATOMICS INTERNATIONAL regards it as a promising reactor type for economical power generation.

The Organic Moderated Reactor, a relatively new approach to economical nuclear power, is particularly appropriate for smaller plants. ATOMICS INTERNATIONAL is completing construction of the Organic Moderated Reactor Experiment for the Atomic Energy Commission at the National Reactor Testing Station in Idaho, part of a development program for the OMR. Basic advantages of the OMR include compact core with good neutron economy, low pressure coolant system, and freedom from corrosion problems. The OMR is also considered promising for ship propulsion, and ATOMICS INTERNATIONAL is making a design study of this reactor type for maritime use.

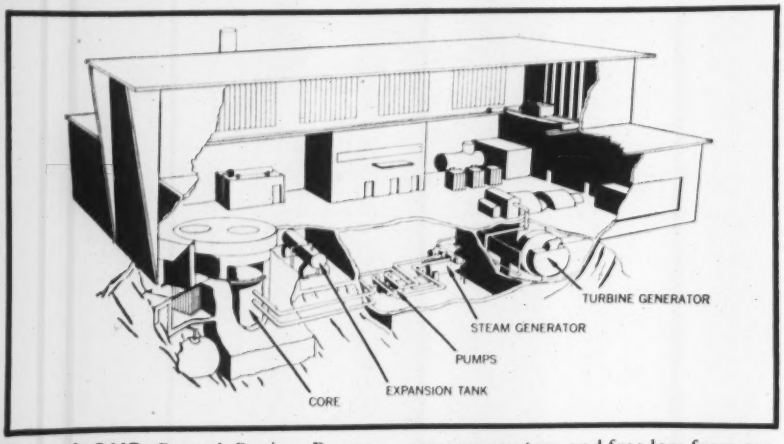
Research Reactors are now being built by ATOMICS INTERNATIONAL for Japan, Denmark, West Germany, and West Berlin. They are similar to the ATOMICS INTERNATIONAL reactor now in service at Armour Research Foundation, Chicago—the first to be designed specifically for private industrial research.

The Laboratory Reactor is a new, low-cost instrument designed specifically to meet the needs of universities and industrial laboratories for nuclear training and research.

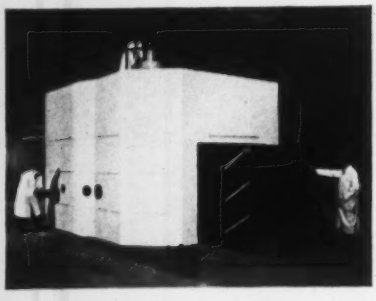
ATOMICS INTERNATIONAL, one of America's major builders of nuclear reactors, is staffed and equipped to help you with any phase of reactor development. Please write: Director of Technical Sales, Dept. ME-73, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, Calif. Cable address: ATOMICS.



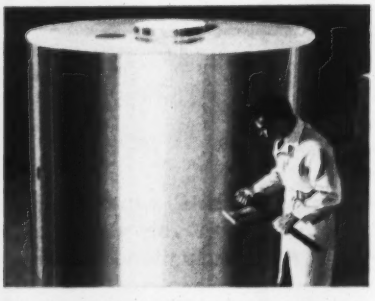
Reactor "heart". An AI technician installs zirconium "cans" containing the graphite moderator in the core of the Sodium Reactor Experiment. The use of a sodium coolant allows a high-temperature, low-pressure heat extraction system with high thermal efficiency of power conversion.



Typical OMR Central Station Power Plant. Basic advantages of OMR include small size, compact core, low-pressure system, and freedom from corrosion problems. This also makes it a promising reactor for ship propulsion.



Armour Reactor is a 50 kw water-boiler unit for industrial research. It has nine beam tubes for experimental purposes.



Nuclear Nutshell. Laboratory Reactor operates at 5 watts of power and produces more than 100 isotopes. It can be operated by one trained man.

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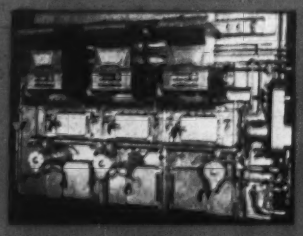
DETROIT ROTOSTOKER



Spreader stoker. Economically burns all grades of Bituminous coal or Lignite. Power, hand dumping or stationary grate types.

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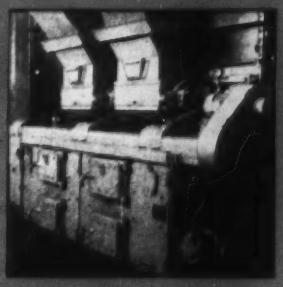
Compact underfeed stoker for smaller boilers. Capacities 3,000 to 12,000 pounds steam per hour. Plunger feed, mechanically driven side cleaning. Coal feed and air supply may be automatically controlled.

DETROIT ROTOSTOKER—TYPE C-C

(Continuous Cleaning) Reciprocating grates that slowly discharge ash at front. Steaming capacities from approximately 5,000 to 75,000 pounds. Smokeless with wide load range.



DETROIT SINGLE RETORT STOKER

(Detroit UniStoker)

Side cleaning, underfeed stokers. Motor or turbine driven. Adjustable feed provides manual and automatic control. Capacity range 12,000 to 24,000 pounds steam per hour.

DETROIT ROTOGRATE STOKER

Spreader stoker for higher capacities up to 400,000 pounds. Forward moving grates that discharge ash at the front. Higher burning rates for longer periods. Heavy duty.

DETROIT DOUBLE RETORT STOKER

Side cleaning heavy duty underfeed stoker with two retorts, mechanically driven. Available for capacities from approximately 20,000 to 34,000 pounds steam per hour. Requires no basement.

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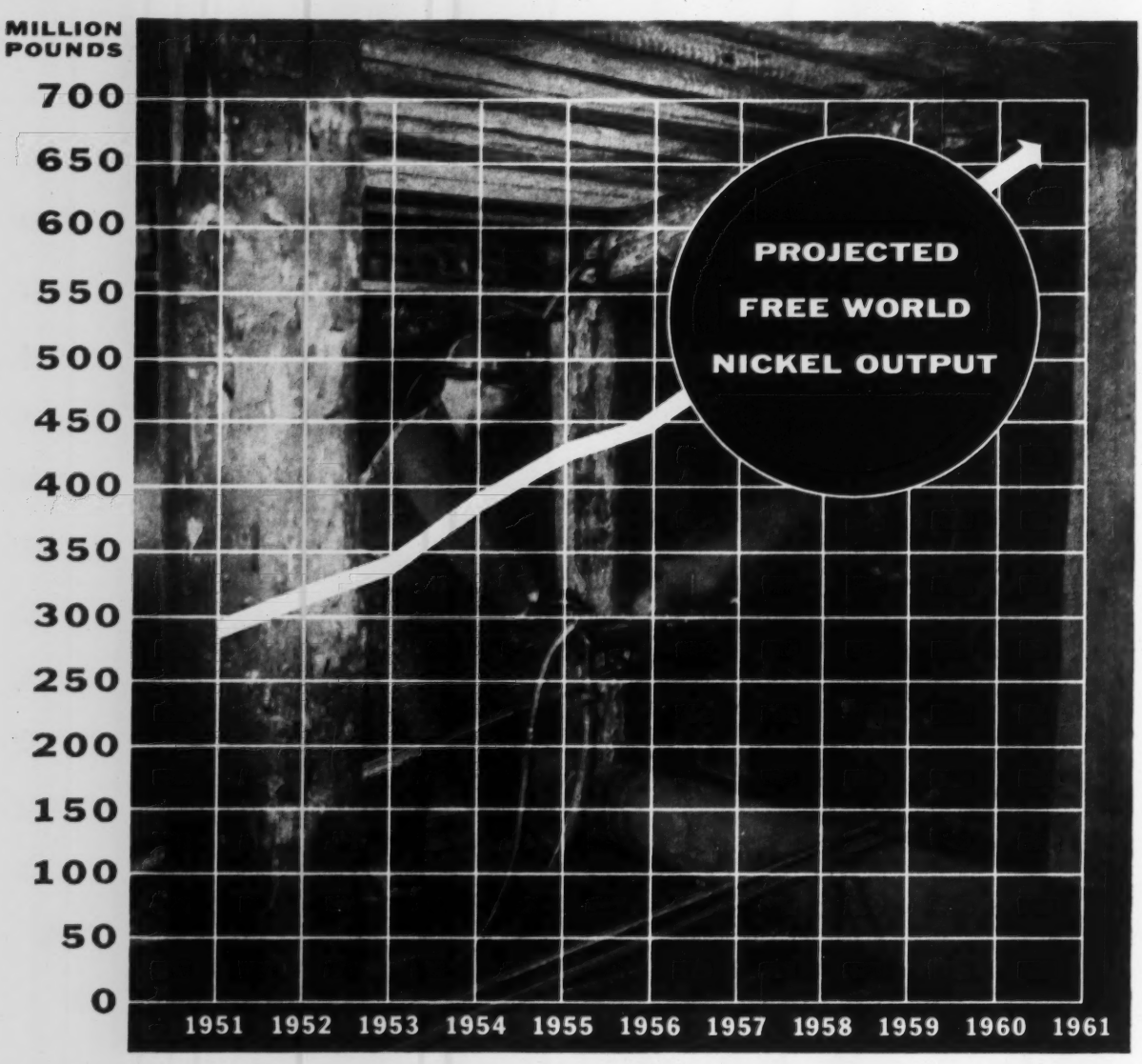

Another 50% advance in nickel industry's production capacity

Paced by Inco-Canada's new developments in Manitoba, producers put 1961 Free World nickel output at 650-675 million pounds a year—up 130% over 1951

In 1951, the nickel industry of the *Free World* produced about 290 million pounds of nickel.

Last year, the over-all output of the industry set a new record high of 450 million pounds.

This was an expansion of more than 50% in five years: a substantial production boost that indeed benefited industry, but only after vital defense and government stockpile needs were given preference.

New Inco-Canada developments help set new goals

Right now Inco-Canada, with years of exploration behind the project, is pushing construction at its new Manitoba mines: developing in the far North a new, big-tonnage nickel-producing area.

In Ontario, at the same time, Inco-Canada is continuing to expand its Sudbury capacity.

In 1961, this should lift Inco-Canada's nickel output to 385 million pounds a year. A hundred million more than in 1956!

With the steadily increasing capacity of all *Free World* producers, in the next four years nickel production should be lifted to the all-time high of 650-675 million pounds a year.

With 1961 capacity anticipated at more than twice what it was in 1951—and with continuing exploration—nickel users are assured of more nickel in their future.

The International Nickel Company, Inc., New York 5, N. Y.

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INCO **International Nickel**

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada)—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

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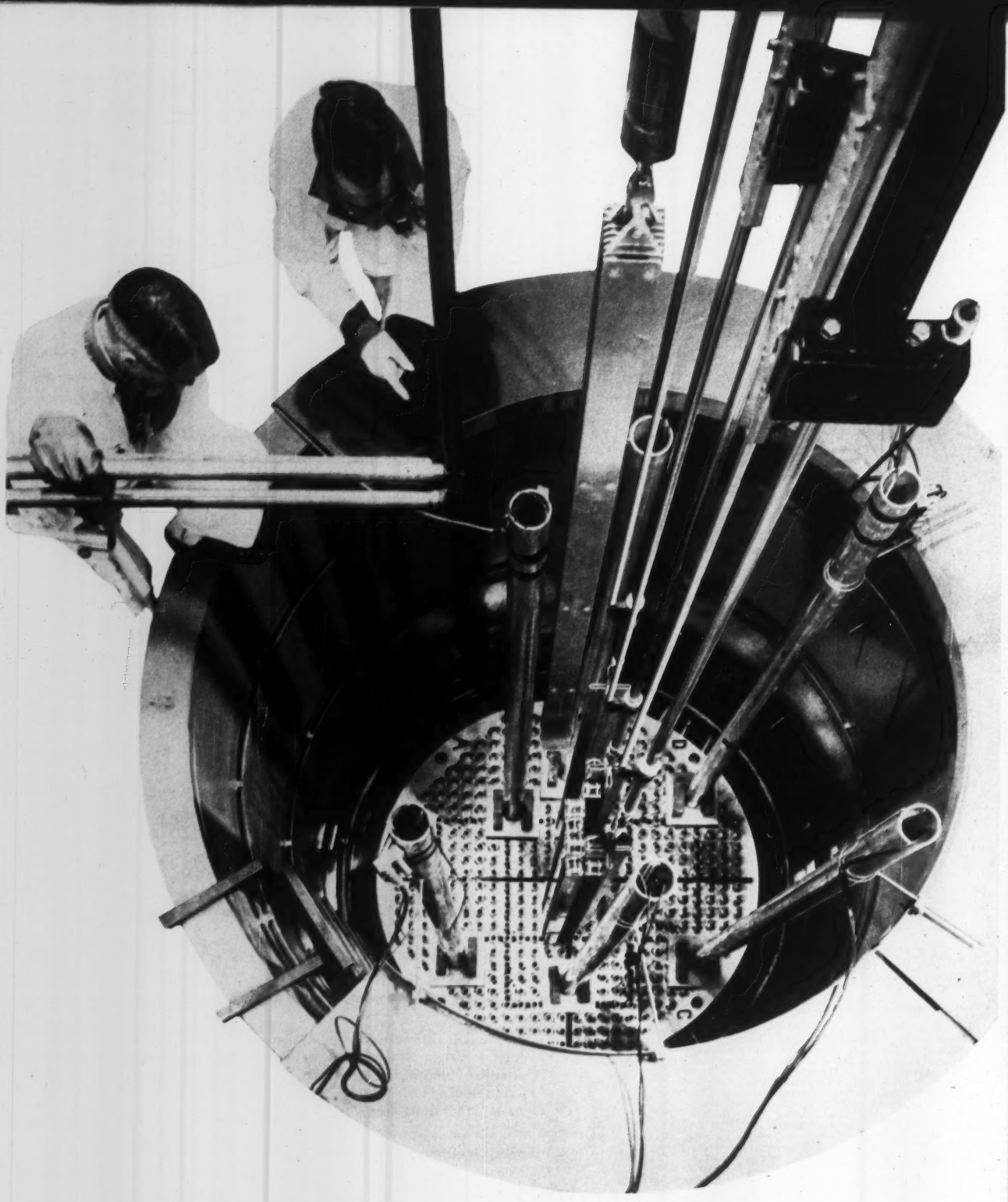

Looking down into tank of The Babcock & Wilcox Company's critical experiment reactor at Lynchburg, Va. Fuel elements comprising "core" stand on pins on round grid plate at bottom of tank. Neutron-absorbing rods, used to control chain reaction of assembled core, are in position among fuel elements. Long tubes extending from grid plate contain various instruments for test and control. This reactor experiment is a vital step in the development of the power reactor which B&W is building for the Consolidated Edison Company at Indian Point, N. Y.

Critical Experiment Reactor

Volume 79 • Number 6

JUNE 1957

MECHANICAL ENGINEERING

George A. Stetson, *Editor Emeritus*
J. J. Jaklitsch, Jr., *Editor*

International Geophysical Year

THE most comprehensive study of the earth ever undertaken will be conducted by scientists throughout the world during the International Geophysical Year. Beginning next month on July 1, the IGY will extend through Dec. 31, 1958. During this 18-month period several thousand scientists representing more than 50 nations will make simultaneous investigations all over the world—of the earth, the atmosphere, and the sun. A score or more years of normal research will be compressed into these 18 months as scientists attempt to get a unified picture of our physical environment.

These scientists will explore almost every major land and sea area. They will study the earth's core and crust. They will probe into its interior with explosion sound waves and send rockets and satellites to explore outer space. They will measure the deep ocean currents and the surging tides in the seas. They will observe and measure the many mysterious particles that continually bombard the earth from outer space.

Answers to a thousand questions will be sought—some of which are: Is the climate of the earth changing? Are glaciers receding? Will melting ice sheets someday flood coastal lands? Where do cosmic rays come from and what is their nature? What causes the aurora? What is the relationship between sunspots and solar flares and long-range radio transmission?

Finding the answers to these and other questions should indeed prove to be of great importance since our environment, especially the atmosphere and the oceans, affects the daily lives of all individuals, the transactions of commerce and industry, the safe conduct of land, sea, and air travel and transportation, and the range of reliability of radio communication and navigation systems. It is the intensive study of the large-scale aspects of this environment which will be carried out during the IGY. Each of the fields in the program is characterized by its global nature and its relation to solar-energy fluctuations and disturbances. Measurements must be made simultaneously so that the relationships between fields can be determined on the basis of world-wide coverage.

The National Academy of Sciences has gathered together the Nation's leading geophysicists to carry out the United States program. This program includes projects in the following disciplines and areas of activity involved in the IGY: Aurora and airglow, cosmic rays, geomagnetism, glaciology, gravity, the ionosphere, longitude and latitude determinations, meteorology, oceanography, seismology, solar activity, and rocket and satellite studies of the upper atmosphere. The United States program will include activity within the continental limits of the United States, Alaska, the Antarctic, the Equatorial Pacific, the waters of the Atlantic and the Pacific, and various co-operative efforts with nations of North and South America.

Probably the most dramatic feature of the IGY, and of prime interest to engineers, will be the U. S. satellite program—Project Vanguard—which calls for the launching of an unmanned scientific earth satellite far into the upper regions to explore the vast area of space which surrounds the earth.

Weighing about 21½ lb and measuring only 20 in. in diam, the tiny "moon" will be launched from Patrick Air Force Base in Florida. Instrumentation contained in the satellite will weigh about 11 lb and will include solar cell-measuring batteries, ion chambers, thermistors, erosion gages, a Minitrack transmitter, meteorite collision memory devices, telemetry coding systems, and Lyman alpha storage units.

A three-stage launching vehicle will get the satellite into its orbit. The first stage, providing a thrust of 27,000 lb, will start the system on the first part of its flight. When its fuel is exhausted, some 40 miles from the launching site and within about 2 min after take-off, the system will have attained a velocity of 3000 to 4000 mph. The second rocket stage will then take over, attaining a velocity of about 11,000 mph, burning out at about 130 miles altitude, and coasting onward. When the system has reached an altitude of about 300 miles, the last rocket will impel the satellite into its orbit at a speed of about 18,000 mph.

Once the satellite is in its orbit, scientific information can be obtained in two ways; first, by observing the satellite from the earth; and, second, by telemetering information from the satellite itself. Project Vanguard will, in fact, be the first step in exploring the unknowns that lie in outer space.

Thus, more than 50 countries are participating in the IGY and are tackling a world-wide effort of tremendous complexity. It should serve as a model of international co-operation and indeed may well serve as a pattern for future international scientific undertakings.

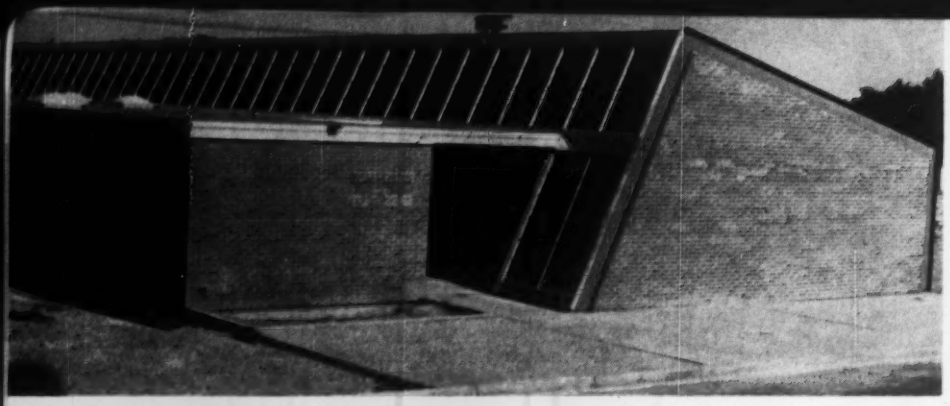

Fig. 1 This view of the Albuquerque Solar Building shows the flat-plate collector which forms most of the south wall. The collector is here used, for the first time, in combination with a heat pump and water storage tank.

Solar Heat for a Building

A report on winter operation and performance in the first solar-heated commercial building

By F. H. Bridgers,[1] D. D. Paxton,[1] and Roger W. Haines[2]

THE first solar-heated office building (owned by the authors' firm of consulting engineers in Albuquerque, N. Mex.) has been operated successfully through the major part of its first winter. It was first occupied in August, 1956. The owners had been attracted to the possibilities of solar heating, and they needed a new office. The result was a structure of unusual architectural appearance, Fig. 1, exploiting the flat-plate solar collector, and presenting new technical problems.

The Albuquerque Solar Building has been described elsewhere (9),[3] therefore only details are presented here. The system includes a sloping, south-facing flat-plate collector, inclined 30 deg from the vertical, and having a net area of 750 sq ft. (Previous articles used the figure of 830 sq ft, but this was gross area and did not allow for shading effects due to mullions, etc.) The collector forms most of the south wall. Other components are a 6000-gal underground water-storage tank; a 7½-ton package water chiller used as a heat pump; water-circulating pumps; an evaporative water cooler, used only during the cooling season; an air-handling unit, and floor and ceiling panels for heating and cooling the building; and interconnecting pipes with automatic valves for controlling the flow of water during the several cycles involved in heating and cooling.

Prior Research

Few scientific attempts to evaluate the performance of flat-plate collectors or other solar-system components were made before 1938. In that year, a research project was begun at Massachusetts Institute of Technology under the direction of Dr. Hoyt C. Hottel and is still continuing (1, 2). Other investigations followed (3, 4) with the result that the basic data for flat-plate collectors are well established and can readily be used in the design of solar-heating systems.

Several residences utilizing solar heating have been built (5, 6, 7, 8). Some of these systems use supplemental heat from electricity or gas during extreme periods. Various materials are used for heat storage, including water, chemicals, and rocks.

The combination of flat-plate collector, water-storage tank, and heat pump, had not been tried until used in the building described in this paper. The use of a heat pump with the solar collector has much to recommend it. In cold and cloudy weather, the storage and collector temperatures may be allowed to fall to very low points (38 deg collector temperature was attained during this first year of operation) with a resultant increase in collector efficiency and storage capacity. The heat pump permits the use of a smaller collector and storage tank. Since the heat pump can also be used for summer cooling, the system becomes more economically attractive.

Trial and Error

Methods were found to overcome operating difficulties which arose (and for which there were no precedents).

Corrosion. The original installation used aluminum collector plates having the tubes integral with the panels. It was necessary to enlarge the end of the tube and weld in a bushing for the rubber hose used to connect the panel to the piping manifold. Unfortunately, a flux was used in the process, and despite careful washing, some residue remained in the tubes so that numerous pinhole leaks appeared when water was turned into the plates. Even more unfortunately, this condition did not appear until a test was made in October, 1956, prior to using the system. It was necessary to remove the glass cover plate and supporting mullions, remove the plates, solder copper tubes to the back side of the plates, and replace the collectors, mullions, and glass. Luckily, it was a warm October.

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[2] Chief Engineer, Bridgers and Paxton.
[3] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Solar Energy Application Committee for presentation at the Semi-Annual Meeting, San Francisco, Calif., June 9–13, 1957, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Paper No. 57—SA-26.

Table 1 Calculations and Recorded Values of Storage-Tank Temperatures

1957 Jan.	Avg out-door temp	Calculated storage temp Begin	Calculated storage temp End	Collector temp Begin	Collector temp End	Collector temp Mean	Coll. eff.	Langleys	Collection MBD	Use MBD	Difference MBD	Storage temp change, F	Heat pump	Weather	Recorded Avail. sun	Recorded storage Begin	Recorded storage End
11	36	45.0	47.8	41.0	43.8	42.4	0.81	244	1422	1382	+140	+2.8	On	Fog	25	46	47
12	42	47.8	56.5	43.8	52.5	48.2	0.81	270	1572	1138	+434	+8.7	On	Cloudy	47	47	50
13	46	56.5	50.2	52.5	46.2	49.4	0.82	112	661	977	−316	−6.3	On	Cloudy	1	50	44
14	55	50.2	69.8	46.2	65.8	56.0	0.85	260	1590	609	+981	+19.6	On	Cloudy	54	44	53
15	46	69.8	82.0	65.8	78.0	71.9	0.66	334	1586	977	+609	+12.2	On	Cloudy	100	53	62
16	36	82.0	80.6	78.0	76.6	77.3	0.51	358	1314	1382	−68	−1.4	On	Cloudy	100	62	64
17	30	80.6	81.3	76.6	77.3	77.0	0.63	366	1660	1624	+36	+0.7	On	Clear	100	64	66
18	32	81.3	73.8	77.3	69.8	73.5	0.51	319	1170	1543	−373	−7.5	On	Cloudy	82	66	63
19	40	73.8	78.6	69.8	74.6	72.2	0.63	338	1460	1218	+242	+4.8	On	Cloudy	74	63	68
20	39	78.6	80.9	74.6	76.9	75.8	0.57	335	1373	1260	+113	+2.3	On	Cloudy	73	68	68

Freeze-Up. When the collector no longer raises the temperature of the water passing through it (e.g., at night or during cloudy weather) a by-pass valve opens and a control valve closes to stop flow through the collector panels. During the night this stagnant water may become very cold and freeze, so an automatic drain valve is provided. After a few weeks of operation, several panels failed to drain since the automatic air vents became plugged and failed to allow air to enter the system. The following morning there were a number of leaks in the collector. A vacuum breaker was installed on the top header and the leaks were then repaired.

Air in System. Draining the panels to prevent freeze-up introduces large quantities of air into the system, resulting in impaired circulation due to air binding of the pumps. Small automatic air vents soon lost their effectiveness. It was necessary to install float-type air vents at carefully selected points in the system. Also, it was found that large quantities of air collected in the top of the storage tank, and this is bled off manually about once a week. No further air troubles have been experienced.

Controls. No serious control problems were encountered. Rather elaborate controls were installed with this system due to the owner's requirements for operation on both heating and cooling cycles, as well as a combination cycle in which the building is being cooled while heat is collected and stored. (This is used in spring and fall when wide daily temperature ranges require a change from heating to cooling and back again in a 24-hr period.)

Performance

Data available cover only November and December, 1956, and January, 1957. Due to lack of adequate instrumentation, only over-all results can be evaluated. For more complete investigation a recording pyrheliometer and 16-point recorder would be needed and these were not available. The principal object of this paper is to compare recorded storage temperatures with those obtained theoretically.

The instrumentation used consisted of several thermometers, some of which were later replaced by a six-point recorder; a water flowmeter for determining flow through the collector; and a watt-hour meter for determining power input. All values were read three times a day: 8 a.m., noon, and at the time collection ceased for the day, usually about 4:30 p.m. The six-point recorder operated whenever the air-supply fan was on, generally from 5 a.m. to 6 p.m. and again in the evening if the building was occupied. This fan is time-clock controlled. Thermometers are ordinary high-accuracy commercial thermometers, in immersion wells in the piping. All thermometers were calibrated to an accuracy of about $^1/_2$ deg F.

Table 1 shows calculations of storage-tank temperatures by the original design method, together with recorded values of these temperatures. (The table shows only a part of the month of January, 1957, to illustrate the method used. Derivations of equations and description of the procedure are shown in the Appendix.)

Fig. 2 shows graphically the relation between recorded and calculated values of storage-tank temperatures for the month of January, 1957. The differences may be accounted for in several ways, some of which are:

1 The calculations are based on U. S. Weather Bureau data which are recorded at a site about 3 miles from the Solar Building. On partly cloudy days cloud conditions may vary considerably from one area to the other.

2 The factor of 2.3 used to extrapolate radiation values from a horizontal surface to a sloping, south-facing

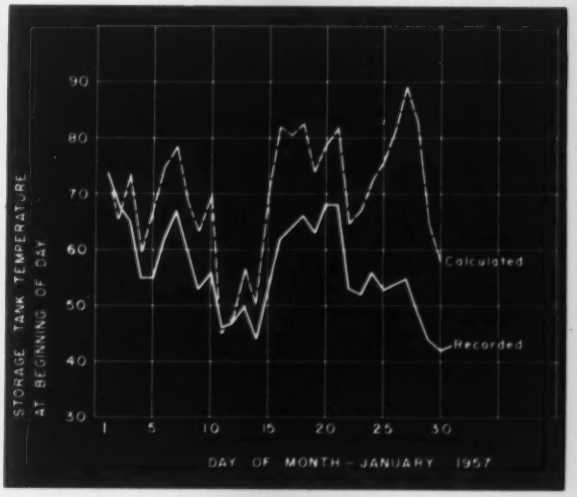

Fig. 2 Discrepancies between the calculated and recorded temperatures in the storage tank are the subject of continuing investigation. Calculations were based on U. S. Weather Bureau data recorded three miles from the Solar Building, and there is also uncertainty in the factor used to extrapolate radiation values from a horizontal to a sloping surface.

surface (see Appendix) is probably incorrect for late January. In addition, the value of this factor diminishes to 1 on very cloudy days, and is decreased to an unknown extent on partly cloudy days. Additional investigation and calculations must be made to isolate the factors causing the discrepancy. This is being done.

Summary and Conclusions

No attempt can be made to evaluate performance in detail as yet. The system has performed satisfactorily through the worst part of the winter, including a much cloudier than normal January. It appears, therefore, that design assumptions are reasonably accurate. Economic evaluation is not possible at this time.

Careful attention must be paid to construction details such as collector drainage and air venting. A vertical panel seems to be the best solution to the drainage problem. Under consideration is a system design with an open tank so that whenever the pump is shut down the collector will automatically drain.

Due to incomplete instrumentation and physical operation problems, there is doubt as to the accuracy of some of the data. It is hoped that both these difficulties will be overcome before the next winter season.

In the meantime, it is felt that a great deal of practical information has been obtained and that the design procedure used is both satisfactory and usable, although it undoubtedly can be refined and improved. Further studies into the effects of other parameters such as sky cover will be made.

Appendix

The equations used in the calculations are derived as follows:

For the heat required: The heat loss was calculated at 118,570 Btu per hr including ventilation air, based on 0 F outside and 70 F inside. For any particular 24-hr period the actual loss should be proportional to the difference between this 70 T.D. and the actual T.D. between 70 F and the average outdoor temperature; this is more simply expressed in MBD (thousands of Btu per day) or:

$$118{,}570 \frac{\text{Btu}}{\text{hr}} \times \frac{1}{1000} \times 24 \frac{\text{hr}}{\text{day}} \times \left(\frac{70 - \text{avg daily temp}}{70} \right) =$$

$$40.6\ (70 - \text{avg daily temp})\ \text{MBD} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ [1]$$

The average temperatures are determined from Weather Bureau records. In practice, the inside temperature was kept at about 75 F during the day and allowed to fall to about 65 F during the night.

For the heat collection: The heat collected is a function of solar-radiation availability, efficiency, and collector area. Solar radiation received on a horizontal surface is recorded by the Weather Bureau. However, this must be extrapolated to the sloping, south-facing surface of this collector. This extrapolation factor can only be estimated. The Weather Bureau Station at Blue Hill records radiation data on vertical surfaces facing each of the cardinal points as well as on the horizontal surface. Jordan and Threlkeld (4) have developed curves for extrapolating these data to other latitudes.

The values also can be calculated theoretically using solar altitude and incident angle. All of these methods give similar results leading to a multiplier of about 2.3. It is hoped that a pyrheliometer can be obtained and mounted on the sloping collector to confirm this.

Weather Bureau data are given in Langleys per day. One Langley is one gram-calorie per square centimeter. A multiplier of 3.69 converts this to Btu per day per sq ft.

Efficiency is largely a function of the difference between collector temperature and outdoor temperature, though it is also affected by cloudiness, particularly at greater temperature differentials. Efficiencies used here are based on the curves developed by Jordan and Threlkeld (4). In determining efficiencies it was assumed that collector temperature was 4 deg below storage temperature and the difference used was that between average daytime temperature and average collector temperature. This required a trial-and-error solution since final collector temperature is not known until calculations have been made for the day.

For those periods when storage-tank temperatures are below 85 deg, the heat pump must be used. In this case some of the work energy goes into the condenser water as heat and must be accounted for. This increase is about 20 to 25 per cent and a factor of 1.2 is used.

The net collector area is 750 sq ft, when all panels are in working order. Due to freeze-up damage, actual useful collector area varied during the winter from 750 sq ft to 708 sq ft. It was necessary to adjust the constants accordingly.

Then, collection equals:

$$\text{Langleys (on horizontal surface)} \times 3.69 \times 2.3 \times 750\ \text{sq ft} \times \text{efficiency} \times \text{heat pump factor} \times \frac{1}{1000}$$

(to convert to MBD)

Or, combining terms and without heat pump, collection equals:

$$6.36 \times \text{Langleys} \times \text{efficiency} \quad \ldots\ldots\ldots\ [2]$$

Calculations were then made to determine use and collection. The difference was added to or subtracted from the storage temperature at the rate of 50,000 Btu per deg storage-temperature change (6000 gal of water).

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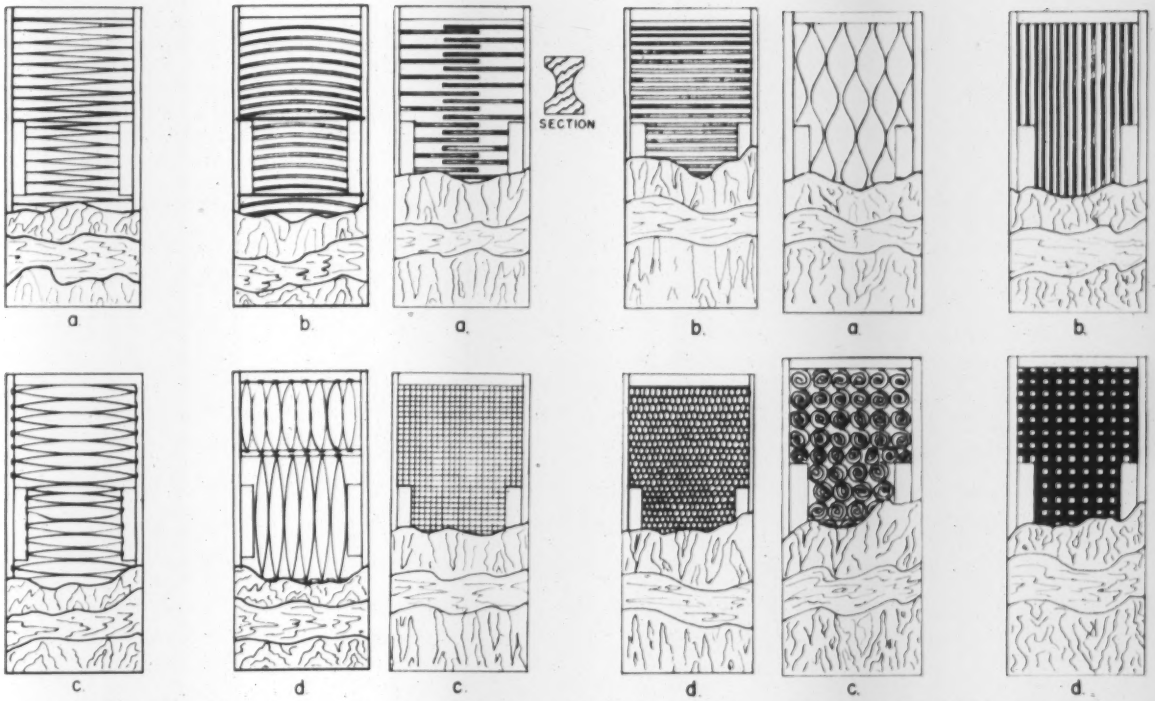

Fig. 1 Hollow core designs for plywood which make use of veneer strips. (*a*, accordion core of the Roddis Plywood Corporation; *c* and *d* are designs by Ernst Doffine, Krefeld, Germany.)

Fig. 2 Hollow core designs for plywood which employ various materials. (*a*, fluted block core of the Roddis Plywood Corporation; *b*, fiberboard strips; *c*, egg-crate pattern; *d*, paper honeycomb cores.)

Fig. 3 Foreign hollow cores. (*a*, undulated strips, *b*, wood blocks, both by Ernst Doffine, Germany; *c*, Placarol wood spirals, licensed to Roddis; *d*, semihollow core, Japan, from the December, 1956, *Architectural Forum*.)

Progressive Management in Plywood Manufacturing

Advantages and disadvantages of various core materials; applications of mechanical processes

By George William Smith, Assoc. Mem. ASME

Plant Manager, Roddis Plywood Corporation, Marshfield, Wis.

ONLY by energetic pursuit of up-to-date methods, new inventions, and modern electrical and mechanical developments will the plywood industry maintain its ability to compete with imports produced at lower costs in foreign countries and the ever-increasing numbers of competing materials such as plastics, decorative metals, hardboard, and others.

As painful as it may be, extensive capital expenditures are a requisite for reduced manufacturing costs, improved quality, and adaptation to modern product developments. Mechanization and automation programs should be carefully organized and planned with the amount of expenditures required being balanced against the amount of money which the company can economically and justifiably approve for any given fiscal period.

Specific appropriation requests should include detailed descriptions, a summary of benefits to be derived, installation cost, and estimated savings for each project. After completion of each project and a reasonable period of experience, actual savings can be computed to compare with the original estimates. By this means results can be measured as the program progresses.

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Core Materials for Plywood

An important consideration in any plywood-manufacturing program is the type of core material to be used. Lumber cores, chipboard cores, paper honeycomb cores, and hollow cores are practical and available. The decision as to which is the best core must be determined

by, first, selecting the use for which the core will be built; the durability required in the ultimate installation; whether cost limitations will confine the selection to a certain price range; and finally, the availability of core materials.

The solid lumber core is more frequently used in installations requiring long life and durability such as schools, hospitals, hotels, and office buildings, or where machining to close tolerances is required before assembly into the final product. These qualities make the solid lumber core highly desirable if lowest cost is not a requisite and the heavier weight of the product will not be a handicap. Lumber cores can easily be cut up into smaller pieces and machined into parts, and for such purposes lumber with low machinability factors should be avoided. An adequate supply of core lumber is often difficult to maintain and prices of this core material are continually moving upward.

Hollow Cores serve many useful purposes, and in some applications no other type of core is as suitable or as desirable. The cost and weight of solid core doors led to the development of the hollow core. Use in home construction has created huge demands for standard sizes, thus permitting the manufacture of large quantities at reduced costs. "Skins" or panels for hollow-core plywood have created a use for lower-grade veneers in the centers and backs. The manufacture of frames for hollow cores is relatively simple. The hollow core combines the features of economy, strength, and service.

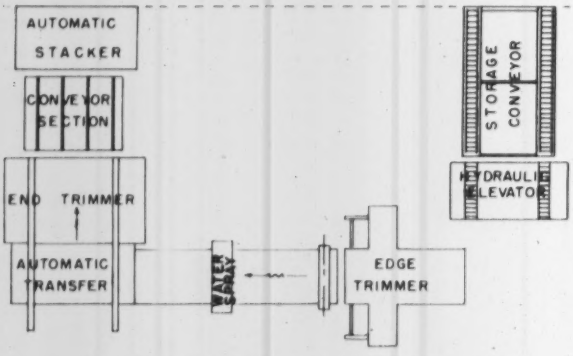

Fig. 4 The door-trimming process automatically trims to size the sides and ends of flush doors using only one operator who feeds the edge trimmer. Approximate savings are $0.18 per door.

Figs. 1, 2, and 3, which are not to scale, are diagram illustrations of a few of the many hollow-core designs in use.

Honeycomb Paper Cores greatly simplify the manufacture of hollow cores as the material is readily available to exact size. It is of extremely lightweight adequate strength, and moderate in cost. However, honeycomb cores should be bonded in a hot press which is usually costlier than cold pressing.[1] The principal disadvantage probably lies in the fact that glue must be applied to the panels prior to assembly, which is more expensive than applying the glue to the frame and core.

Chipboard Cores. It is difficult to be overenthusiastic about chipboard cores, for they offer tremendous possibilities for the future development of plywood products. There are numerous variations of chipboard materials and some types are referred to as particle board or shavings board. Composed mostly of waste materials, the problem of material supply is at once diminished. Properly compounded, its machining and "hardware fastening" properties may excel natural woods in some respects. Stresses, tensions, and warpage are at a minimum. Bonding qualities are excellent. Flatness and smoothness are easy to obtain. Certain types are available which are smooth enough to permit faces to be glued directly to the core without the use of crossbands.[2] The extent of applications is virtually unlimited, and there are already indications of more possible uses than the available supply of material. A typical practical application is in fireproof doors, whereby the fireproofing chemicals are mixed with the chips before being pressed into core material.

Mechanization of Plywood-Manufacturing Processes

The popular concept of automation as exemplified by a machining line for automobile engines, for example, is fraught with animated devices actuated by hydraulics, electronics, pneumatics, transfers, relays, microswitches, linkages, controls, and so forth. These devices are as practical, as essential, and as much at home in plywood manufacturing as in metal working or other types of processing plants.

Figs. 4 to 9 present some examples where mechanized and automated processes have successfully reduced costs.

[1] "Importance of Plywood in Door Construction," by T. D. Perry, *Woodworking Digest*, October, 1956.

[2] Wood particle board consisting of 3 layers with 2 outer layers composed of relatively high resin content and carefully sized particles, manufactured by Roddis Plywood Corp.

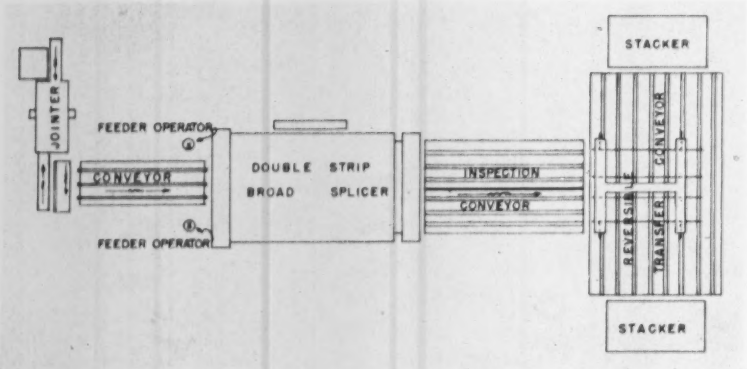

Fig. 5 A plan view of a processing unit for splicing veneer-core material which feeds strips edgewise into the German-made Torwegge broad-splicer where joining is accomplished by heat and pressure. Inspection is performed on the off-bearing conveyer to maintain rigid quality control of the core material. The transfer conveyer delivers both strips to one stacker. When the load is full, the transfer conveyer is reversed to deliver the single-ply panels to the other stacker while the first one is being unloaded. Approximate savings are $0.07 per panel.

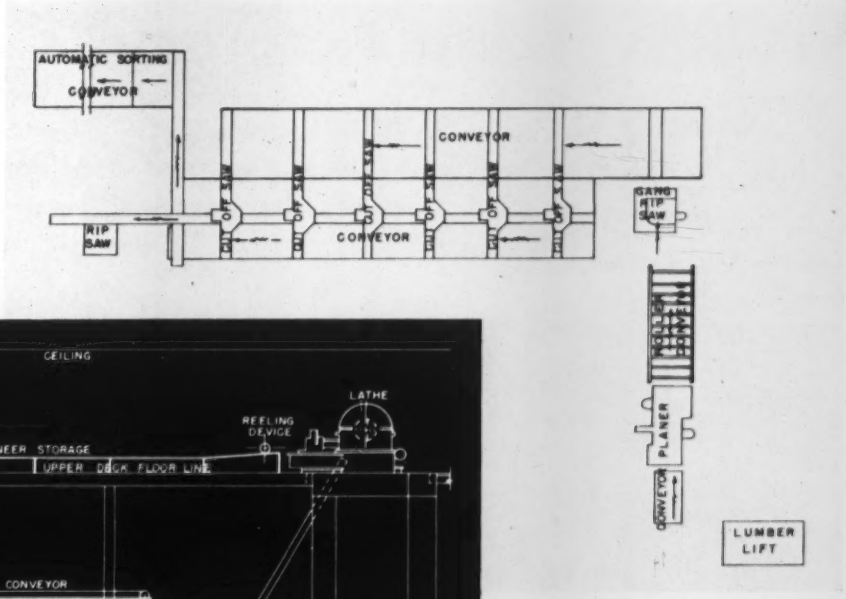

Fig. 6 ▶ Lumber-processing line to manufacture core material of various grades, species, and sizes. Smooth material flow and a minimum of material handling result. Approximate savings are $3.53 per 1000 board ft.

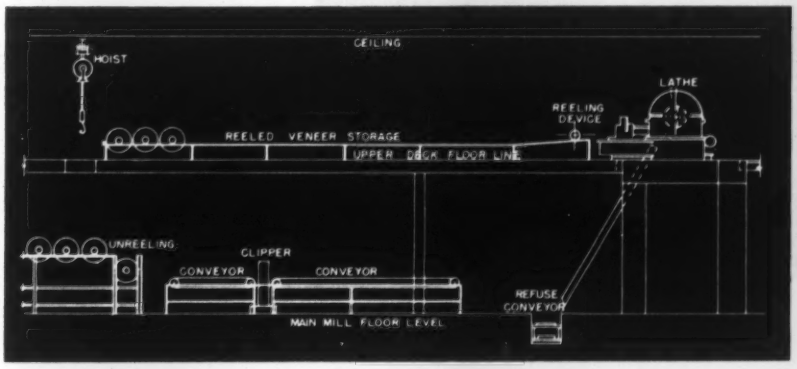

Fig. 7 ▲ Veneer lathe operations on assembly-line basis provide a reeling system after which the veneer is dereeled and clipped for book matching. The raised position of the lathe and the reeling deck afford easier and lower cost production than similar equipment mounted at the floor level. Approximate savings are $2.47 per 1000 sq ft.

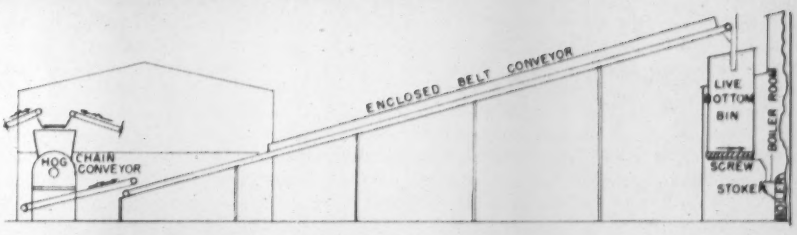

Fig. 8 ▲ Fuel-conveyer system illustrates the importance of cost-reduction mechanisms in nonproduction operations. This arrangement mechanically reduces waste wood to fuel, transports it to conveyerized fuel lines, and feeds it into the boiler for burning. Savings are intangible as this operation would probably not be attempted without conveyers.

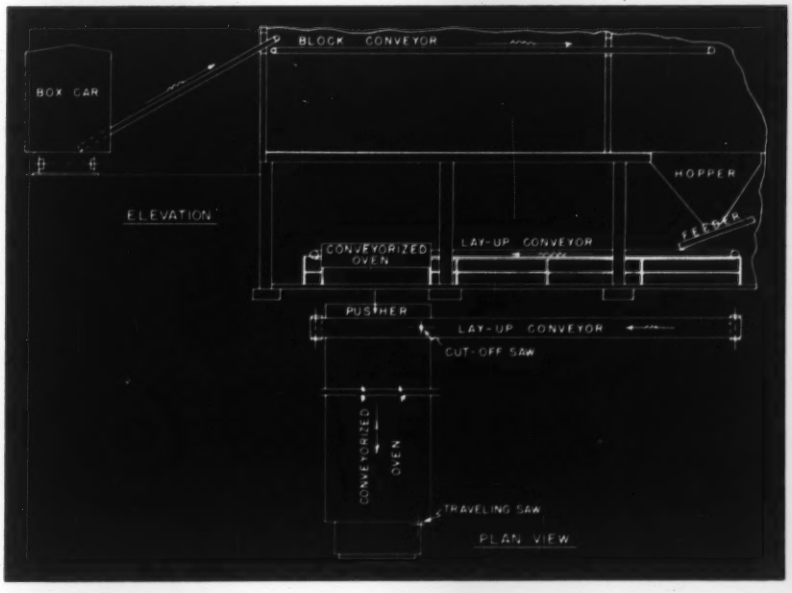

Fig. 9 ◀ Assembly-line system for processing door cores by unloading pine blocks directly from railroad cars by conveyer, through a gravity-feed hopper onto the lay-up conveyer. Approximate savings are $0.12 per core.

Woodworking Accuracy

Dimensional control reduces hand-fitting problems, lowers production costs, and improves the competitive value of the product

By Henry B. Pittman, Jr.

Quality Control Engineer,
Morgan Manufacturing Company, Inc., Black Mountain, N. C.

THE average woodworker has seldom thought, and cared less, about how accurately he could control the dimensions of his product. He knew that wood warps, checks, swells, and shrinks; but such things were to be expected because of the nature of the material. He has no conception of the accuracy demanded and obtainable in the metalworking and plastics industries where parts are commonly machined to 0.0001 in., and sometimes 0.000001 in. Nor does he realize the opportunity afforded through controlled temperatures and humidities to improve his own product.

In attempting to deal with accuracy of measurement and humidity control instead of two separate problems, there is actually only one major question - dimensional control. Although some steps have been taken in an effort to obtain this control, they have, in many cases, been abandoned because they were not economically feasible or because they were unworkable from a practical standpoint. Some few plants have installed and are using more accurate methods of measurement. Others have undertaken to control relative humidity in certain parts of their operation. But very few woodworking plants have attacked the problem as a whole.

Recognition of Problem

There is a definite need for this control and it is being recognized more and more by the industry in the face of increasing competition and the decrease in the higher grades of lumber over the past few years. Quality control has come into the foreground, with some manufacturers making use of statistical-control charts from the dry kilns to the finishing departments. Others have some statistical control but rely principally on better and closer supervision. But whether the program is simple or elaborate, set-up machining variations and variations caused by moisture changes must be coped with.

Accurate Measurements

In approaching a practical solution to these problems, accurate measurement and the establishment of working tolerances which the machines are capable of holding are of equal importance. Unrealistic tolerences are worse than none at all. The proper method to determine the capabilities of a particular machine is to make a statistical-control chart on the operation of the machine. From the upper and lower-control limits of this chart it is possible to obtain the design tolerances necessary to build pieces of furniture without excessive fitting.

After determining the tolerances, the next step is the use of a sufficiently accurate method of measurement. The Southern Furniture Manufacturers Association's report in 1952, on dimensional control research in the furniture industry[1] fully described the procedure for determining proper tolerances and also two systems of measurement by which the tolerances can be maintained in machining. The first makes use of individual go-no-go gages for length and width of each part of a case. The second utilizes adjustable or universal gages incorporating dial indicators.

A production test was conducted at the Drexel Furniture Company's plant in Drexel, N. C., using the individual go-no-go gages on a French Provincial vanity which had been in their line for several years. An analysis was made to determine permissible tolerances and the gages were designed to maintain those tolerances of ± 0.010 in. The design of the gages was somewhat unusual in that the set-up tolerances of ± 0.003 in. were combined with the acceptance limits of ± 0.010 in. This was accomplished by machining four shoulders on one end of the gage. The two center shoulders were used to check set-up tolerances and the two outer shoulders to check the production run. Extensive records were kept of measurements, time spent in machining, assembly, and casefitting. Substantial savings were effected which amount to about 8 per cent of direct labor in the cabinet room and the elimination of two casefitters. Even with this saving, however, the initial cost of these gages was out of reach of a relatively small manufacturer. With this in mind adjustable gages were designed which were low in price, fast and simple to operate, easily read, very accurate, and yet not delicate or easily distorted.

The gage finally designed incorporated a dial indicator graduated either in $^1/_{64}$ in. or in 0.001 in. The gage itself consisted of a $1^1/_2 \times 2$-in. $\times$ 5-ft steel bar, mounted on a 5-in. "I" beam with slots at 1-in. intervals and a "V" groove milled out down the center. A cylindrical anvil was made with a steel pin through the center which fitted this groove. When the pin was in the slots the face of the anvil or stop was accurately positioned, Fig. 1.

The production test using the adjustable gage was

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[1] "Cost Savings in Furniture Manufacture by Accurate Dimensional Control," by H. B. Pittman, Jr., and E. S. Johnson. The Southern Furniture Manufacturers' Association, High Point, N. C., 1952.

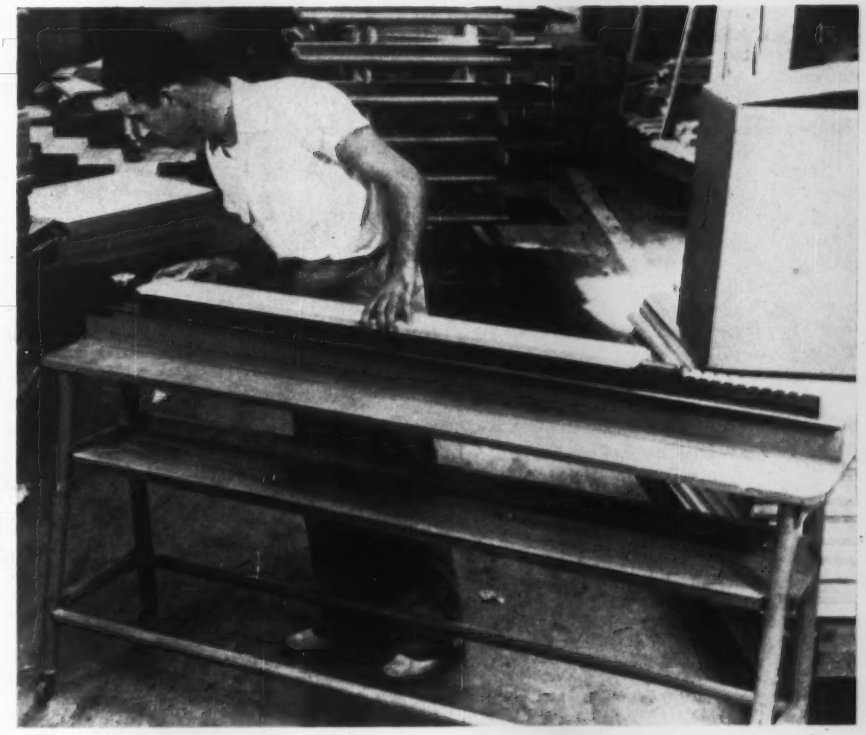


Fig. 1 A simple adjustable gage used in a dimensional plant which is low in price, fast and simple to operate, easily read, very accurate, and yet not delicate or easily distorted

made at one of the Broyhill Furniture Factories, the Lenoir Chair Company, Plant 2, at Newton, N. C. A low-priced straight-lined modern chest was selected for the test. Again, savings were greatest in the cabinet room, consisting of a decrease in the work necessary for casefitting and over-all labor savings amounting to about 8 per cent, as well as marked improvement in quality.

Humidification

Either method of measurement, or a combination of the two, may be adopted in a furniture or woodworking plant to help eliminate machining variations. However, the value of the gages is substantially reduced unless the dimensions so accurately held in the machining operations are maintained during storage or subsequent operations. Complete summer and winter air conditioning is the Utopian answer to this problem, although it is almost prohibitive economically. The next best thing is controlled humidification during the winter months.

As pointed out by F. W. Mohney,[2] many plants suffer from "equilibrium moisture content sickness." EMC is a factor often forgotten in the woodworking industry but a very important one and capable of a great deal of damage. Surface checks, open joints, end splits, cupped panels, and warped stock are all examples of the visible damage caused by uncontrolled EMC. The invisible effects may be even worse. If part of an assembly has swelled or shrunk it presents a problem. If the shrinking has taken place before machining and a damp period causes it to swell before assembly, or vice versa, it will not fit properly. If the piece swells or shrinks after machining, the same problem is present. Without proper control these changes may be daily as well as seasonal. Opposite extremes of moisture conditions can occur in the southern Appalachian area overnight, especially in the fall, winter, or spring. When a warm damp period is followed by extremely cold dry conditions, this can be disastrous. DeWitt Skinner[3] cites a very good example.

Skinner relates that, in October, 1953, very little heating was required since it was a mild month with the indoor relative humidity averaging about 42 per cent. At this relative humidity, the wood being processed in plants in this general area had established a 7.8 per cent EMC. A very sudden cold wave moved in on Nov. 1, 1953, dropping indoor average relative humidities down to 17 per cent with accompanying conditions of 3.8 per cent EMC. The wood in process rapidly gave up moisture and began to warp, check, crack, and change dimensions. Since the cold wave lasted for almost three weeks all the wood reached the low of 3.8 per cent EMC, and the damage stopped, except that veneers became hard to handle, urea-resin gluing became difficult, and there were various other inconveniences.

When warm weather finally returned for 5 days with an indoor relative humidity of 54 per cent and a 9.8 per cent EMC, the wood immediately began to pick up moisture, causing swelling, warping, and more dimensional changes. Another cold wave arrived at just about the time the wood began to reach equilibrium and the cycle was repeated. If these conditions had been controlled so as to keep to about a 7.5 per cent EMC, the damage

[2] "E. M. C.—Forgotten Factor," by F. W. Mohney, *Wood Working Digest*, vol. 37, November, 1955, pp. 63-66.

[3] "How to Stop Losses Caused by Changes in Relative Humidity," by DeWitt Skinner, *Furniture Production*, August, 1954.

Table 1 Relative Humidity Indoors When Outside Air at 75 Per Cent Relative Humidity Is Heated Without Adding Moisture

Outdoor temperatures, F	Indoor Temperatures 70 F rel. humidity, per cent	75 F rel. humidity, per cent	80 F rel. humidity, per cent
−20	1.5	1.3	1.1
−10	2.5	2.2	1.9
0	4.4	3.8	3.2
10	7.2	6.2	5.3
20	11.6	9.9	8.4
30	18.1	15.5	13.2
40	26.8	22.7	19.5
50	38.2	32.6	27.9
60	54.0	46.0	39.4
70		64.0	54.8

Source, Armstrong Machine Works, Three Rivers, Mich.

Table 2 Pounds of Steam Required per 1000 Cu Ft of Space per Hr to Obtain Desired Indoor Relative Humidity at 75 F, at Various Outdoor Temperatures, Assuming Two Air Changes per Hr and Outdoor Relative Humidity of 75 Per Cent

Outdoor temperature	Desired Indoor Relative Humidity, Per Cent 30	35	40	45	50	55
			(Steam, lb)			
50		0.065	0.200	0.335	0.470	0.605
40	0.197	0.332	0.467	0.602	0.737	0.871
30	0.393	0.528	0.663	0.798	0.933	1.067
20	0.543	0.678	0.813	0.948	1.083	1.218
10	0.643	0.779	0.913	1.049	1.183	1.318
0	0.708	0.843	0.978	1.113	1.248	1.383
−10	0.749	0.884	1.019	1.154	1.289	1.423
−20	0.774	0.909	1.044	1.179	1.314	1.449

Source, Armstrong Machine Works, Three Rivers, Mich.

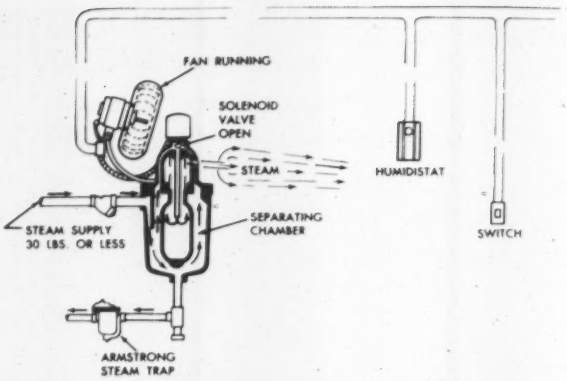


Fig. 3 Schematic drawing showing operation of a steam humidifier

could have been eliminated almost completely. Instead of a 6 per cent change in EMC there would have been only a 2.3 per cent change when the EMC went up to 9.8 per cent.

Indoor relative humidity is very low during winter months from Florida north. At the extreme low, outdoor temperatures often drop to 0 F with 75 per cent relative humidity. When this air is heated inside the plant, conditions drop along with the relative humidity. From Table 1, it may be determined what the indoor relative humidity is when outside air at various temperatures is brought inside and heated without adding moisture.

As an example, take a 0-F day with an outdoor relative humidity of 75 per cent. Indoors, at 75 F the theoretical relative humidity will be only 3.8 per cent

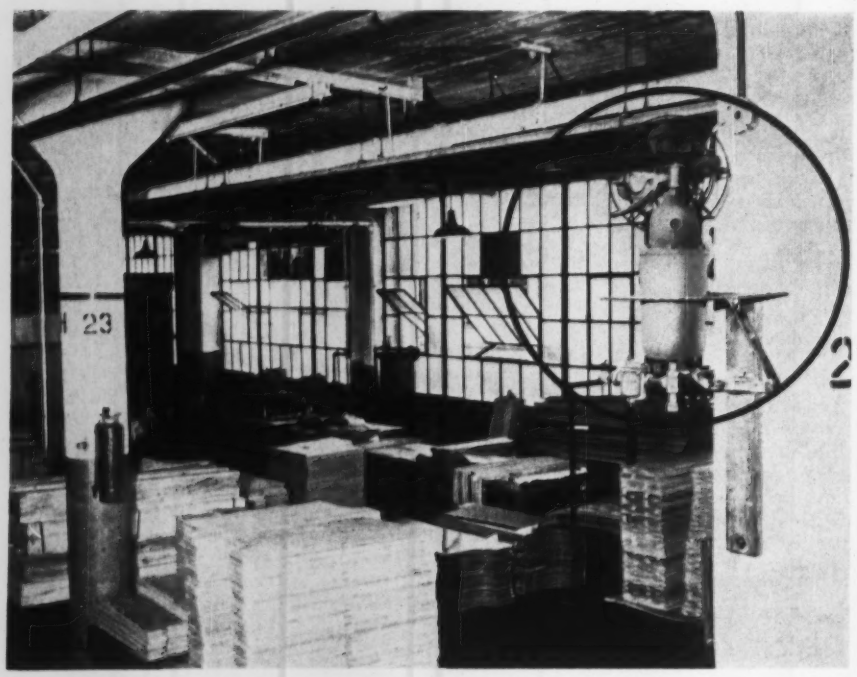
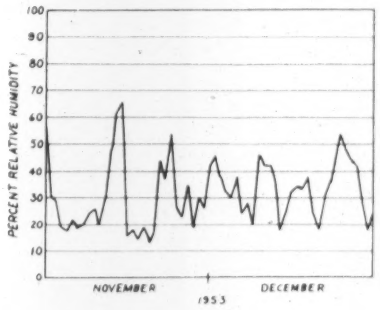


Fig. 2 A steam humidifier in service in a woodworking plant

with a corresponding 0.9 per cent EMC. Actually, the relative humidity may be a little higher because of the moisture being taken from every hygroscopic substance in the room—wood, paper, and people.

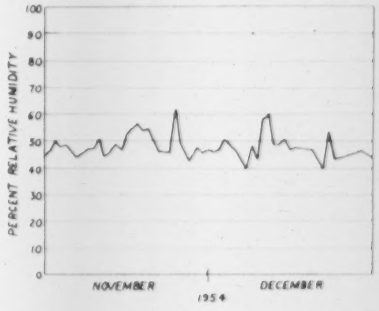
The foregoing indicates that addition of moisture to the air being heated is almost an absolute necessity. The question is, how to add this moisture in the correct amounts, and by an economical method. Moisture can be added to the air in a number of ways, including such crude methods as sprinkling water on the floor, hanging wet cloths on steam pipes or radiators, and opening pet cocks in steam lines—all of which are economical but do not provide much in the way of control.

The result desired can be achieved by lowering the inside temperature. If, in the foregoing problem, the indoor temperature was lowered to 20 F, the EMC would be approximately 7 per cent. Since this is impractical, the only logical way is by controlled humidification. Several commercial humidifiers are on the market and



◀ **Fig. 4 Variations in relative humidity during November and December, 1953**

Fig. 5 Variations in relative humidity during November and December, 1954 ▶



it is possible to install these units at comparatively low costs.

Many plants merely broadcast a very fine spray of water into the air which then evaporates. The water vapor combines with the air to give the desired humidity and emc. However, minute droplets of water that do not evaporate sometimes fall on whatever is in the room. Other disadvantages are that when the water evaporates, the mineral content of the water may settle as dust on any stock in the room and the heat loss from evaporative cooling must be compensated for by the application of outside heat.

An excellent source of humidification is low-pressure exhaust steam. Commercial steam humidifiers operating on 30-lb steam pressure or less are quite efficient, Fig. 2. The price of these units is moderate and installation is relatively simple. Operating and maintenance costs are low. There is no heat loss as with water spray units since the steam adds its heat content as well as humidity to the room, decreasing the amount of heat normally needed, and steam humidifiers cause no dust or droplets of water to settle.

Some of the unique features of the steam humidifiers are shown in Fig. 3. When the relative humidity drops slightly below the desired level a solenoid valve, actuated by the humidistat, admits steam to the separating-silencing chamber. Steam passes from this chamber directly to the atmosphere. The fan helps disperse the steam. When the relative humidity again reaches the desired level, the humidistat closes the solenoid and stops the fan. The steam trap drains any condensate which forms in the body of the humidifier. The hot steam surrounds the separating chamber and evaporates any condensate that might enter it. This insures that only dry steam will enter the room atmosphere.

When plant management decides to install a system of humidification, a representative of a manufacturer of humidifiers can survey the plant and make the best recommendations for adequately humidifying the areas in question. If the survey is made by the plant's own engineers, the basic data that must be obtained are dimensions of the room or building, building construction, available electric current and steam pressures. Data on air changes and air movement are more difficult to obtain and are the most important. The use of an anemometer is usually required, and since the humidifiers will be used in cold weather, this survey should be made in cold weather to determine the amount and course of air movements when windows are closed.

In a dimension plant, the best results are obtained when the gages and humidifiers are used together. In an operation of this kind much more emphasis must be placed on quality than in the ordinary furniture plant where minor variations can be covered by subsequent operations. The customers of a dimension plant, buying completely machined wood parts, expect to receive better parts than they could make in their own plant.

The gages when used in conjunction with micrometers, calipers, and other instruments reduce the hand-fitting problems of Morgan Manufacturing Company's customers to a bare minimum. The humidifiers do their part during the heating season to keep the various wood parts from changing dimensions from one machining operation to the other. This insures purchasers of dimension stock that it will be as accurate as the human element will allow.

Results of humidification do not end with more accurate machining. The occurrence of open glue joints, checks, splits, warp, and other defects caused by low humidities was reduced to almost nothing immediately after the humidifiers were installed in the Morgan Manufacturing Company plant in the fall of 1954. During the first winter of operation the relative humidity in the plant was never below 40 per cent and the EMC was never under 7 per cent.

Variations in relative humidity that existed in November and December of 1953 are shown in Fig. 4. It can readily be seen by comparison with Fig. 5, which shows humidity conditions for the comparable period of 1954, that conditions were greatly improved after the installation of the humidifiers.

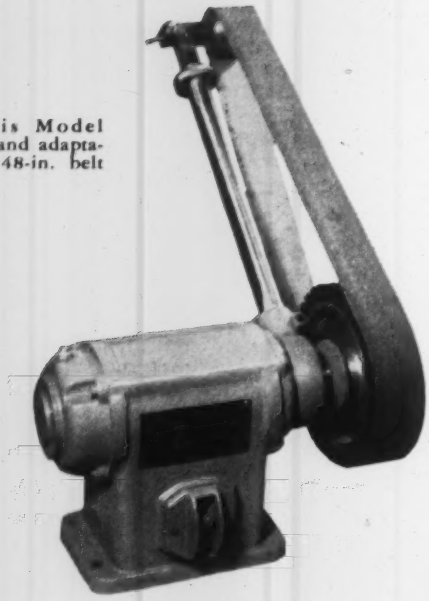


Fig. 1 Curtis Model DBAO, small and adaptable, 2-in. × 48-in. belt

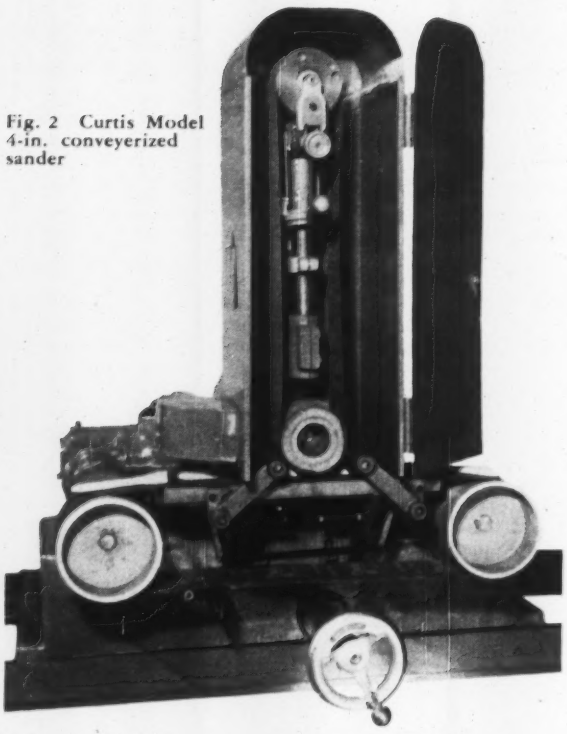


Fig. 2 Curtis Model 4-in. conveyerized sander

Automatic Sanding

Higher wood-machining feeds, faster cutting tools, better and faster drying and finishing machines, and conveyerized operation all point to the elimination of costly manual sanding

By L. G. Brown, Mem. ASME

Manager, Engineering and Manufacturing,
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The need for so-called "automatic sanding" has been apparent for several years. Higher wood-machining feeds and speeds with carbide-tipped cutting tools have meant high volume production ahead of the sanding. Automatic sanding development has been slow. Better and faster drying and finishing materials have expedited production after sanding. Increased labor costs over many years have made manual sanding expensive, increasing the demand for immediate development of "automatic sanding."

Developments in material handling over the past years have been an outgrowth of the high production demands of the automotive and bulk-handling industries and have resulted in a large variety of conveyers; also automatically controlled unstackers, pilers, and feeders of various types. All of these mechanisms are useful tools to the automatic machinery builder.

Contributed by the Wood Industries Division for presentation at the Wood Industries Conference, Winston-Salem, N. C., May 16-17, 1957, of The American Society of Mechanical Engineers. ASME Paper No. 57—WDI-6.

Improvements in Sanding Machinery

During the past nine years there have been many decided improvements or developments in the wood-sanding machinery field. Great strides have been made with coated abrasives for improving the product life under increasingly severe conditions, still maintaining the final quality of the sanded surface. Resin-type bonds are making new records each day.

Conveyerized sanding machines were initiated by endless-bed-type drum sanders, cutoff machines, and tenoners. Pinch rolls and variable-speed feeds together with floating pneumatic-sanding pressures combine to obtain automatic sanding, and result in a more uniform, higher quality product.

Many types of new-abrasive belt-sanding heads can be

adapted from heads formerly developed for the metal-grinding trade.

Figs. 1, 2, 3 show heads of various belt lengths utilizing the serrated contact roll backup of the abrasive belt. These contact rolls can be furnished in various durometer hardnesses to suit the sanding operation. Dynamic cutting caused by various land-to-groove ratios increase belt life considerably, while increasing rate of cut.

A conveyerized machine using the contact roll for sanding is represented in Fig. 4.

Fig. 5 illustrates use of a "deadhead" or platen-type backup for the same type conveyerized machine.

The Curtis Model 91 edge sander, shown in Figs. 9 and 7, utilizes this same roll-serrated principle stretched out in the form of a contact belt. Easier, high-speed sanding results with increased belt life, in most applications.

Square bedposts, having their turnings inside of the square dimension, lend themselves to automatic sanding on flats provided of course that they are reasonably straight throughout their length. In this case automatic turnover of the posts between belt sanding simply imitates the manual operation. A relatively new sander is also available for automatically sanding two sides at a time on tapered bedposts.

Since all beds have four posts and each post has four sides to sand, the savings by "automatic sanding" can be quite impressive over former drum or manual-belt sanding.

Fig. 8 shows the "Molsander" for sanding any lengths of variously shaped moldings. Parts are fed end to end for high quality production.

Some formed or shaped parts such as serpentine, French Provincial, or other similar contoured parts can be sanded using a conveyer with a cammed, floating-contact roll head. Dead-heads can be interchanged for final finishes.

One type of proposed automatic edge sander is similar to a two-unit double tenoner. This sander will include four belt-sanding heads incorporating interchangeable rolls or dead heads. Heads are adjustable for width or length of panel and rotate to take edge sanding of either horizontal or vertical-grain direction. The heads must float under diaphragm-type cylinder pressure to avoid excessive sanding.

Fig. 9 shows the new Curtis Model 1000 Smooth-Matic panel polisher, the first approach toward automation in flat-belt polishing. Here a contact-pad belt, running inside of and in line with the abrasive belt, simulates many hand blocks creating sanding pressure. Since there are 37 pads running at 1400 ft per min we have the effect of 28 sanding pads acting each second at any one portion of the work table. Hardness of these pads may be varied to suit sanding condition.

Panels are fed with the grain perpendicular to the direction of travel, resulting in high production. The resulting finish is entirely free of streaks since the cut is continuous. Cork belts can be substituted when satin or wax finishes are desired. Limit switches and vertical pneumatically operated sanding backup cauls assure no rounding of leading or trailing edges. Stock feed is infinitely variable.

Currently these machines are being manufactured in single and double-head models. A roller-table-type unit, manually operated, makes this type of polisher available for either large or small production.

All of the above units used in conjunction with drum sanders, semimanual belt sanders, stroke sanders, scroll, Nash spindle or covered-work sanders, pneumatic drum, Vonnegut, and many other types make up the tools for automation of wood sanding. We have the conveyers and electrical, pneumatic, and hydraulic controls. Now let us study the arrangements.

Types of Automation in Sanding

Modern furniture-production automation seems to classify into three main categories predicated on plant layout.

New plants, usually of one-floor construction, favor straight-through, in-line-type flow of material with intermittent transfer trucks to shift work from one section to another where necessary. Generally, the machines are arranged so that the work flows to and from the machines, always in straight line of sequence,

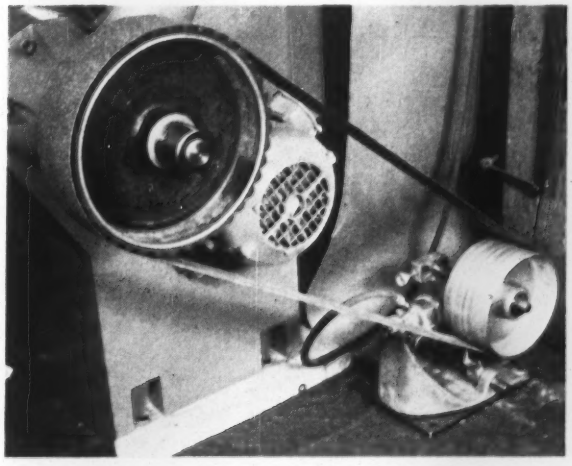


Fig. 3 Curtis Model BS4 backstand and serrated contact roll

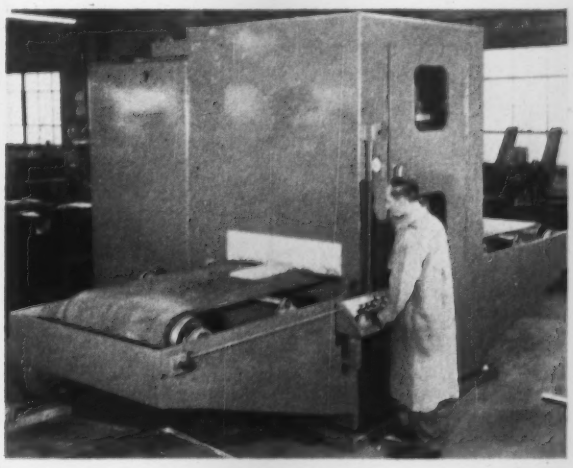


Fig. 4 A conveyerized machine which uses the contact roll for sanding

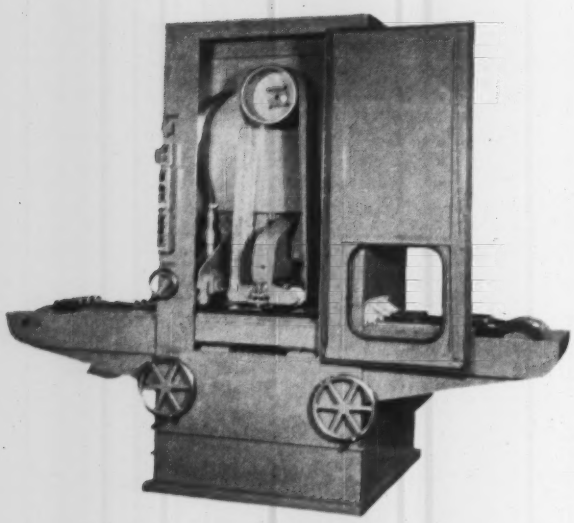


Fig. 5 The "deadhead" or platen-type backup for the same type of conveyerized machine shown in Fig. 4

on roller, slat or fixed-bed-type conveyers, either of gravity or powered-belt type. Operators are required to feed and tail the machines. Production possibilities can be quite high, yet the sequence can be quite versatile. The over-all operation is set up for a given type of merchandise.

Slightly older plants have followed the practice of using overhead or other types of conveyers to carry parts from one operation to another. Machines are arranged along the conveyer in operational sequence. Chief benefit is that the machine operator does not have to load or unload trucks of material for ultimate delivery to the next operation. At least one operator runs each machine. The machines are of manual type. The line is versatile if the conveyer has sufficient length. Set-up time is at a minimum, making this type of production quite desirable for small plants. Unit-operation time determines the number of machines required.

Transfer conveyers will usually cut handling costs at least 15 to 20 per cent simply because they relieve the operator of unpiling and piling of the flat of parts. Obviously, workmen must also keep up with the conveyer speed, which is an automatic incentive or agitator, whichever the case may be.

A third method which can usually be applied to either older or newer plants has the principal aim of reducing labor time. Machines are grouped in their operational sequence using any necessary automatic feeders or pilers.

Although labor is reduced and production is higher, the arrangement requires adequate inspection and a relatively higher grade of set-up man or operator. The operation follows that of modern automotive plants more closely and is highly specialized for the type of product. This arrangement requires seven men less than the previous one.

Standard feeders may be purchased for most flat-panel type of work. Special feeding and transfer units may necessarily be developed if economical.

Obviously, workmen must feed the machines whenever choice of panel faces or edges is involved. Normally, however, this choice can be made when stacking the panels at the previous operation.

Because the polisher feeds transversally, the production rate is very high and may require two or three operators for feeding. Of course, automatic-transverse feeders can be utilized for ordinary rectangular-panel stock when desired. Brushes or air blasts can be furnished for automatic action to clean the parts prior to finishing.

Wherever glue sizing is necessary between polishing steps, the polishing heads can be furnished singly

Fig. 6 The Curtis Model 91 edge sander utilizes the roll-serrated principle stretched out in the form of a contact belt

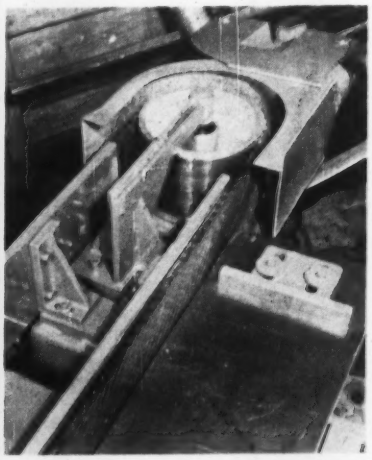


Fig. 7 Close-up of the sanding contact belt on the Curtis Model 91 Edge Sander. Easier, high-speed sanding results, with increased belt life, in most applications.

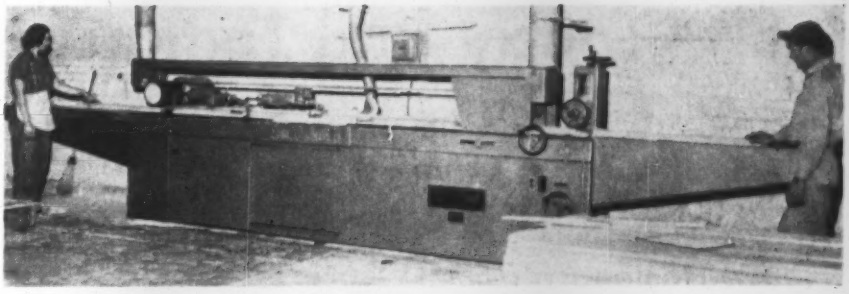


Fig. 8 The Molsander Model 100 will sand any length of variously shaped moldings

with conveyerized glue sizing and drying between the polishing heads.

Subsequent automatic polishers can be added in tandem for finer finish, specially waxed or final satin finishes, incorporating a single transfer conveyer throughout the entire polishing operation.

This machine gives the smoothest, finest finish obtainable automatically.

One function that cannot be entirely automatic is that of visual inspection. Let us not forget that the final test of any finishing machine is the opinion of the inspector or operator that the product is satisfactory. Although we have several surface-roughness indicators available, these are only guides as to the final appearance of a product. In wood products, the final appearance of the grain after finishing with lacquer, paint, or varnish is governed by the salable appearance. For this reason the sanding operation can never be entirely "automatic" but must be left to the discretion of the sanding foreman or the opinion of management.

Economy of Automatic Sanding

It has often been said by economists, who ought to know what they are talking about, that business spending for plant and equipment is the basic driving force in the progress of this country's economy.

Not so long ago the Department of Commerce made a survey which showed what investment in equipment has meant in output per man hour since 1929. These figures show that the production of manufacturing industries has risen more than 140 per cent while the man hours necessary to produce this output have increased only 40 per cent. The increase in physical capital to accomplish this production gain was approximately 78 per cent.

Progressive wood-products manufacturers have proved that capital spent on engineering, research, development, labor-saving machinery, and automatic material handling can, in the long run, cut costs and also produce profits.

This requires the utmost co-operation between management, engineers, machinery, and material-handling manufacturers. Each one has his own responsibility.

We can conclude that automatic sanding is economically beneficial to all manufacturers of wood products and, with the combined enthusiastic co-operation of everyone concerned, will make great advances in the near future.

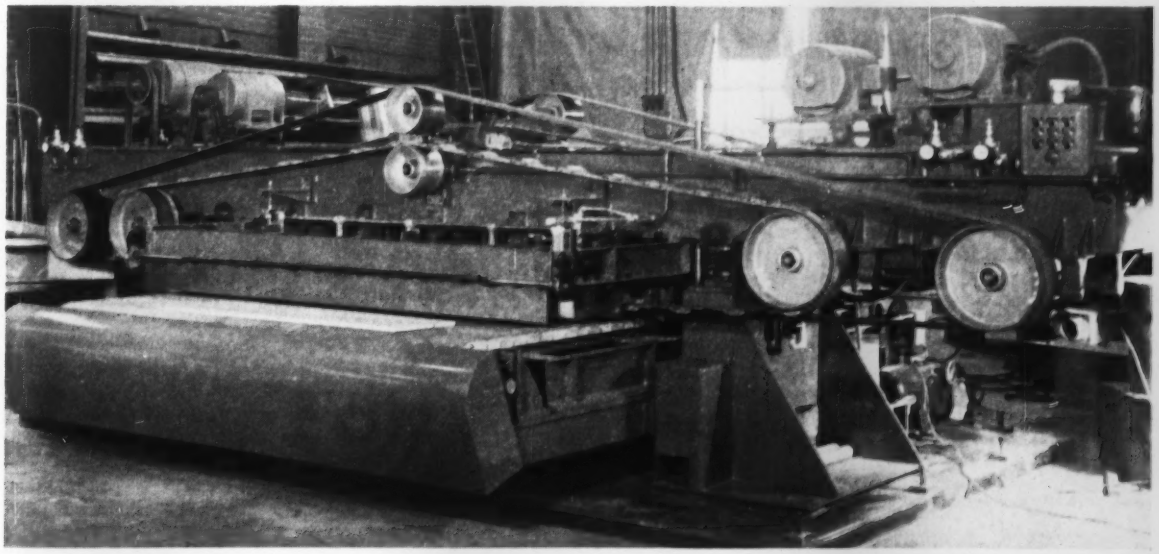


Fig. 9 Curtis Model 1000 Smooth-Matic panel polisher represents the first automation approach in flat-belt polishing

Fuels—Today and Tomorrow[1]

The changing pattern of fuel demand. Three studies, from close-up to long-range view

Relative Demand for Fuels[2]

FLUCTUATIONS in real income of fuel users are generally most important in explaining the annual demand of a fuel. But the ratio of demand per unit of income (or per unit of use of another fuel) also changes significantly, and is usually related to price.

Elasticity Coefficient

The elasticity between two economic variables is the ratio of a proportional change in one variable to a proportional change in the other—for example, the ratio of the percentage by which demand responds to a one per cent rise in price (probably a negative figure). Such a coefficient is independent of units of measurement and thus is very useful in comparing different sets of data. The nationwide demand for bituminous coal in all uses has a competitive elasticity of −1.7 when the price deflator is a weighted average price index of oil and gas, and the income deflator is Gross National Product in constant prices and the observations are annual data.

The nationwide demand for marketed production of natural gas since 1940 has a wholesale elasticity of demand and a competitive elasticity of demand, both of approximately −1.0. As might be expected, the competitive elasticity for commercial consumption is twice that of residential use, −2.1 and −1.1, respectively. For petroleum, the wholesale elasticity for the period since 1925 is about −1.0, and the competitive elasticity with coal is about the same. Petroleum price has little effect compared to "real" income in determining demand variation. Petroleum consumption has been rising faster than Gross National Product in constant dollars at a rate that appears to be independent of the relative crude petroleum price rise in the postwar period. The ratio of consumption of crude petroleum to real GNP has been rising about 0.6 per cent per year.

The wholesale elasticity of demand for all fuels taken together for the United States since 1927 is low, −1.0. This is not an easy figure to interpret. The question is: What can be substituted for fuel? No single commodity can be substituted, but fuel use can be economized in response to fuel price increases. This is seen in large boiler fuel use and in internal-combustion engines, but the trend to extra power in automotive engines and more weight per car about offsets the trend to more efficient fuel use. The range of relative variation of fuel use to real income has not been great, nor has the real price changed greatly over the last generation.

The national picture of competition among fuels is quite different from that of smaller areas. In Massachusetts and Connecticut, the elasticity of substitution of coal over oil, for the eight largest electric generating plants using both fuels in appreciable amounts, is much larger than the national values, ranging from −4.0 to −10.0. Such high values indicate great sensitiveness of consumption of an individual fuel to relative price.

Due to higher elasticities of demand, specific price changes affect certain competitive subregions more than a region as a whole. Thus, public policy designed to affect energy price changes is likely to be of greater public concern to those more affected areas.

Trends and Prospects in Coal[3]

The domestic market for bituminous coal has shifted radically, under the competitive impacts of oil and gas, and as the result of ever-changing technology. Railroads, which once consumed 20 per cent of total coal production, are now dieselized. Residential and commercial use of coal has shrunk; new homes tend to use gas, while old ones have switched to oil. The market that remains is subject, in the long run, to less competition from other fuels, and it is an expanding market.

Coal Marches On

The electric power industry has become the largest single coal customer. In 1955, 140 million tons were consumed by thermal electric plants, and it is held likely that coal will retain its share (two-thirds) of this market, and the share could rise. 107 million tons of metallurgical grade coal were consumed by the coking industry, mostly for domestic steel. General industrial consumption exceeded 106 million tons, and exports amounted to 51 million. Electric power, steel, and exports are considered to have excellent growth prospects and are characterized by a relatively stable demand for coal. This stability encourages new investment and makes for continuous employment.

Price Trends. Coal prices have shown a long-run rise of significant proportions, but this must be viewed in relation to the general inflationary trend. After adjustment for changes in the general price level, and with allowance for sharp annual variations, the rise has conformed to an increasing exponential trend averaging $1\frac{1}{2}$ per cent annually since 1910.

When prices are charted by states, noteworthy trends

[1] Based on three papers contributed by the Fuels Division and presented at the Annual Meeting, New York, N. Y., Nov. 25–30, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Condensed from "Competition and Substitution in Demand for Fuels," by Paul W. McGann, U. S. Bureau of Mines, Washington, D. C., ASME Paper No. 56—A-189.

[3] Condensed from "Trends and Prospects in the Coal Industry," by Perry D. Teitelbaum, National Planning Association. The views expressed are the author's and do not necessarily represent those of the National Planning Association, or its Project on the Productive Uses of Nuclear Energy.

appear in Montana and North Dakota, as well as in Colorado, Wyoming, and Utah. In the first two states, a downward trend has been maintained for at least 30 years. In view of their enormous strippable coal and lignite deposits, the trends clearly demonstrate the effect on prices of continuous improvements in earth-moving technology and equipment. Relatively stable prices in Colorado, Wyoming, and Utah appear unrelated to costs in mining, reflecting the pressure of competing fuels, since locally produced gas and oil have been in surplus supply.

productivity as before. Greater profits favor continued investment, while an expanding market for new mining equipment favors technological improvements.

Transportation trends. With new methods of shipping coal, there has been a shift away from complete dependence on railroads. Seventy-nine per cent of all bituminous coal in 1953 was shipped from the mines by rail, compared to 84 per cent in 1947.

One transportation technique of the future involves a 50 per cent mixture of coal slurry and water in long-distance pipelines. Another prospect is long-distance

Table 1 Average Hourly Earnings (Current Dollars)[a]

	1947	1948	1949	1950	1951	1952	1953	1954	1955
Bituminous coal mining	1.74	2.05	2.12	2.28	2.51	2.61	2.89	2.95	3.16
All manufacturing	1.30	1.41	1.47	1.56	1.70	1.79	1.90	1.95	2.03
Durable	1.35	1.48	1.55	1.64	1.79	1.90	2.00	2.07	2.17
Automobile	1.52	1.67	1.77	1.93	2.00	2.26	2.38	2.45	2.55
Iron and steel	1.49	1.64	1.73	1.84	2.07	2.19	2.40	2.45	2.62
Nondurable	1.23	1.33	1.39	1.46	1.59	1.65	1.73	1.80	1.85
Building construction	1.76	1.93	2.02	2.13	2.30	2.42	2.60	2.74	2.80
Class I railways	1.30	1.40	1.54	1.69	1.86	1.97	2.03	2.09	2.11
Telephone	1.43	1.48	1.61	1.55	1.65	1.75	1.85	1.94	2.00
Wholesale trade	1.31	1.40	1.46	1.53	1.64	1.73	1.83	1.90	1.98
Retail trade	1.04	1.12	1.17	1.22	1.31	1.37	1.45	1.51	1.56
Agriculture	0.55	0.58	0.56	0.56	0.63	0.67	0.68	0.67	0.69

[a] Figures in this table include allowances for fringe benefits, based on annual ratios of total employee compensation to wages and salaries for each industry separately, as derived from the Department of Commerce national income statistics.

Table 2 United States Energy Consumption, Projected to 1980[a]

Source	1955 Conventional units	1955 10^{15} Btu	1955 Per cent of total	1980 Conventional units	1980 10^{15} Btu	1980 Per cent of total
Bituminous coal (million short tons)	423	11.0	27.0	897	23.5	28.9
Anthracite (million short tons)	23	0.6	1.4	10	0.3	0.4
Crude petroleum and products (million barrels)	2807	16.8	41.3	6500	37.7	46.3
Natural gas (trillion cu ft)	10.1	10.9	26.8	16	17.2	21.1
Hydro (billion kwhr)	118	1.4	3.4	277	2.7	3.3
Nuclear energy (billion kwhr)						
Total		40.7	100.0		81.4	100.0

[a] Projections for any one fuel are meaningful only when shown with similar projections of all the important fuels. When projections for nuclear energy are available, they will be subtracted from other sources, mainly bituminous coal.

Wage Trends. Productivity in underground mines is estimated (1955 data) at 1.1 tons per man-hour; in strip mines it is nearly three times as high. The average for the entire industry is 1.3 tons per man-hour, or over 10 tons per day. In mines using continuous mining equipment, output has been at least 4 tons per man-hour. It is expected that productivity will continue to grow through expansion, development, and improvement of continuous mining. About 23 million tons were produced with this equipment in 1955, against a total of 470 million. Geologically, most continuous mining equipment requires coal seams at least 3½ ft thick, and there are adequate reserves of at least this thickness.

Table 1 reveals the rapid rise in hourly earnings in coal mining, and supports the conclusion that miners, in the future, will tend to stick to mining rather than move to other industry. There may therefore be less pressure on coal operators to pay out in wages as much of the rise in

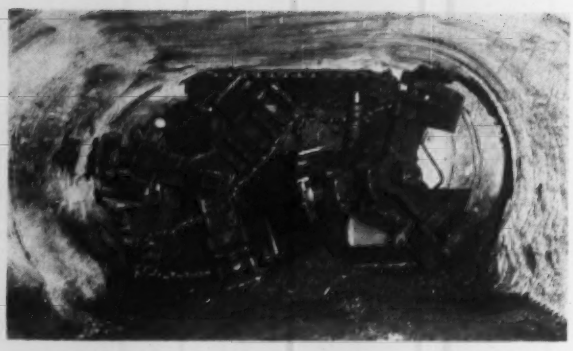
conveyer belts. Barge traffic will continue to increase, and the increasing combination of mine-mouth power generation with either long-distance transmission (as a result of improvements in power-transmission techniques), or locational shifts of industry to nearby sites, can also yield savings in coal transportation costs.

Long-Run Projection

As part of the National Planning Association's Project on the Productive Uses of Nuclear Energy, the author has been engaged for the past year in a study of energy consumption. The figures are shown in Table 2, projecting to the year 1980.

Some of the underlying assumptions are:

Gross National Product, expressed in 1955 dollars, will increase from $3.90 billion to $900 billion (an annual growth rate of almost 3½ per cent); total energy con-



Goodman boring-type continuous miner, with cutting units extended for advance into a coal seam. The cutting height is 7 ft, width 13 ft.

sumption will double; introduction of shale oil on a commercial scale, conversion of coal to oil, and/or petroleum imports will be adequate to permit continued supply of refined oil products without undue price rise; increases in natural gas demand will slow down as field prices rise and as growing storage capacity near consuming centers permits cessation of summertime off-season "dump" sales to industrial consumers; natural-gas reserves will be adequate for demand; electric power consumption will approximately triple.

Fuels for the Future[4]

Future markets for all fuels are limited only by our imagination, our resourcefulness, and our ability to maintain control over our economic destiny. Obviously, a global war could upset the projected future, as could any lessening of our freedom of competitive enterprise. But assuming that the political and social climate remains favorable, the new look for fuels is a bright and challenging one.

Estimates by the Bureau of Census forecast a population of over 228 million in 1975. This may be low. A straight projection of the present trend would indicate 243 million in 1975, or nearly a 50 per cent increase in the next 20 years. Such an increase, if standards of living remained static, would press the petroleum and gas industries to supply demand, and should step up bituminous coal production to an annual rate of 750 million tons.

But standards of living will not remain static. By the end of 1975, increased consumption should be 50 per cent due to higher standard of living, and 50 per cent due to increased population, doubling fuel and power consumption in 20 years.

The Upgrading Process

The trend is toward the use of materials that require more energy per unit weight or volume for their production and fabrication. For example, aluminum, whose consumption is rising faster than that of older metals, requires more energy than do many of the materials it is replacing, such as steel, copper, lumber, paper, or cement. Synthetic building materials, plastics, and fibers, use far more energy than the natural materials, to fit them for the market. As a reflection of this upgrading process, the electric power industry, which has been doubling every ten years, has recently increased its pace so that it is doubling now in eight years.

The fact that energy demand will grow does not mean that all fuels will share equally, though it is inconceivable that the competition from any one fuel will reverse the growth pattern of another. Before 1930, petroleum and gas supplied 31 per cent and coal 66 per cent of the nation's total energy requirements. Now the relation is reversed, and oil and gas supply 67 per cent, and coal only 29 per cent. But demand for all fuels continues at an increasing rate.

New Technology

Technological advancement will make coal more competitive, especially among large-tonnage users. The most promising developments are in mining, preparation, handling, and transportation. In the latter case, the proposed network of pipelines to carry coal under water pressure seems to be especially significant. In addition, new developments in coal-fired gas turbines, gasification, chemicals from coal, and other methods of utilization, give promise of a better place for coal.

The trend of crude oil output in the United States coincides almost exactly with that of Gross National Product, but the trend in the consumption of petroleum products is greater, so that dependence on foreign sources will increase. Future problems of the petroleum and natural-gas industries will be those of providing supplies, rather than finding markets. Technological development will facilitate location of deposits, permit deeper drilling, and reduce cost of transport. Eventually, synthetic liquid fuels and fuel gas manufactured from coal and shale will play significant roles.

In many nations where it is more economical to make large capital expenditures than pay the higher prices for coal and petroleum, development of atomic energy will proceed rapidly. The British already have one commercial plant in operation, at Calder Hall.

In the United States, industry and government are committed to the expenditure of some $300 million for the construction of six major nuclear-power plants having a total capacity of 800,000 kw. The AEC and the Navy are spending huge sums on the development of reactors for use in an 85,000-ton aircraft carrier, a cruiser, and a number of submarines. When the conventional fuels come into short supply, or become too expensive, energy from the fission of uranium or thorium, or even fusion of the atom, may supply much of our heat and power.

The Solar Gambit

In the meantime, the development of solar energy will go forward. Novel applications are already in evidence, such as the silicon solar battery, and furnaces based on reflection of solar energy and used for testing guided-missile materials at extremely high temperatures and for melting of refractory materials in a clean atmosphere.

The ASME has recently organized a Solar Energy Applications Committee to review the many fields of sun-produced power in which mechanical engineers are interested.

[4] Condensed from "The New Look for Fuels," a talk presented by Clyde Williams, Battelle Institute, Columbus, Ohio, at the Fuels Luncheon during the 1956 Annual Meeting.

AIR BRAKES . . .

. . . For High-Speed Ultra-Lightweight Passenger Trains

By T. H. Bickerstaff

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Atchison, Topeka & Santa Fe Railway System, Topeka, Kan.

A general description of five different approaches to brake equipment on ultra-lightweight passenger trains. None of these approaches meets with the general approval of all, and thus it is impossible to obtain agreement as to one right or correct scheme. Each manufacturer constructs his own system, introducing various points of emphasis which suit his own thinking. There is no alternative but to canvass each idea, compare it with others, and draw as reasonable a conclusion as possible. More definite judgments must wait for more careful analysis of the actual performance of each system.

STARTING and stopping of trains are complementary factors in the problem of making time between stations; therefore it is evident that the best results can only be obtained where both factors are given due consideration. Generally, the starting factor is the only one fully considered, or at least the one most fully provided for. Better results can be obtained if both are considered and a more efficient brake system installed. The importance of the brake would be more fully appreciated if we could eliminate the impression that it is a safety device only, and realize that it contributes as much or more than the locomotive to faster and more frequent service. The same consideration should be given to its design and installation that is accorded to other parts of railway equipment.

Modern Design Requirements

The early method of setting about to design a brake for a specific service, without thorough appreciation of the manner in which all the pertinent factors combine to provide a definite and usually predictable retarding force, cannot serve today. As understanding with respect to a certain operation becomes complete, new requirements are introduced. These call for further pioneering to provide new brake functions, or to extend the range of current equipment capacity. A knowledge of the behavior of fundamental factors to embrace new speeds, weights, and operating practices is also desirable.

Little can be said regarding braking factors that is not common knowledge—the governing factor being adhesion between the wheel and rail as well as between the wheel and shoe. Therefore the highest possible retarding frictional force that can be obtained with a brake would almost equal the adhesion of the wheels to the rail. With present rail conditions some sort of wheel-protection mechanism is a "must."

Modern methods of automatically adjusting braking effort to take advantage of the substantially constant adhesive resistance at the rails use either an inertia governor, sensitive to retardation rate, or special governor element which approximates inertia-governor operation by recognizing the relationship between increasing retardation rate and decreasing speed. Of various forms, the wheel-slide detector is a device of proved merit in the reliable performance of its function.

At the present time, five separate types of braking systems are in use on ultra-lightweight high-speed passenger trains. It is the purpose of this paper to briefly describe each system in general.

Contributed by the Railroad Division and presented at the Annual Meeting, New York, N. Y., Nov. 25-30, 1956, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from ASME Paper No. 56—A-66.

Jet Rocket

The No. 26 brake equipment was developed especially for modern lightweight trains. It is an automatic type, designed to produce accurate responsive performance and flexibility of control, and is comparable to present-day electropneumatic straight air-brake performance on trains up to 500 ft in length. The No. 26 brake equipment requires only one pipe throughout the train for brake control, which makes it compatible with standard equipment. Proved and accepted automatic emergency features are retained.

The No. 26 control valve is relatively small in size, modern in design, and of lightweight construction. The design features include a service valve which combines the basic functions of both the control and relay valves commonly used with standard D-22 brake equipment. This permits the mounting of all control parts on a single pipe bracket. When this equipment is used with a high frictional composition brake-shoe material which requires only one half to one third the force used with cast-iron shoes, additional advantages can be gained through the use of a smaller reservoir and brake cylinders. his permits considerable weight reduction in the air-brake control and the foundation brake equipment.

Technical progress has made possible a greatly simplified valve structure. Sensitive long-travel diaphragm pistons and O-rings are used. Ring leakage and the need for expensive lap-fitting are eliminated. Less skill should be required to maintain the control valve with this simplified construction.

For locomotive-brake equipment, the control valve is basically the same as that used for car equipment. In

Fig. 1 The unit-brake mechanism which can be used with the No. 26 brake incorporates the brake cylinder, slack adjuster, and required foundation brake parts in a compact space or enclosure

addition, a new compact lightweight 26-A type locomotive brake valve has been developed to operate with the 26 control valve. With the 26-A brake valve, the degree of brake application is determined by the relative position of the handle in the braking quadrant. This is accomplished by a self-lapping and pressure-maintaining control portion of the brake valve. Small increments of brake-pipe pressure change are readily obtainable.

Electrical elements can be added to the No. 26 control equipment to provide electropneumatic operations for longer trains, if desired. This system includes automatic follow-up of electropneumatic service application in the event of electrical failure. The electrical elements pilot changes in brake-pipe pressure, thereby retaining the single-pipe system used with the automatic brake equipment.

Light wheel loads permit the use of single-shoe type brakes with either metal or composition shoe on vehicles which normally would use clasp-type brake rigging. With the single-shoe arrangement, considerably less space is needed and simpler rigging is required with fewer component parts to maintain.

The unit-brake mechanism which can be used with this equipment incorporates the brake cylinder, slack adjuster, and required foundation brake parts in a compact space or enclosure, Fig. 1. The levers or cam arrangement used to multiply the forces are greatly simplified. The compactness of these units made possible by the higher frictional performance of composition shoes permits a higher braking ratio than otherwise would be possible on lightweight trains where space is restricted.

The unit-brake mechanisms have higher efficiency than normal brake-rigging arrangements. Fewer levers and pins are required, thereby reducing friction losses. Individual unit-brake mechanisms are used with each brake shoe, insuring positive and uniform shoe clearance. They can be removed and replaced individually, greatly simplifying routine maintenance.

Owing to the semiarticulated type of design, only 16 axles are employed on a 12-car train—the first, third, fourth, sixth, seventh, ninth, and twelfth cars having only one axle, hence the wheel load of 9000 lb on axles of the second, fifth, eighth, and eleventh cars and 7600-lb wheel load on the remaining axles. The brake cylinders are 50 cu in. rotor chambers operating at 60-psi service pressure and 70-psi emergency pressure with 90-psi brake-pipe pressure. These develop 3600 lb brake-shoe force on the heavy axles and 3000 lb brake-shoe force on the light axles.

The locomotive is equipped with the conventional 6-in. × 8-in. UAH brake cylinders developing 5050-psi brake-shoe pressure on wheels with a load of 30,000 to 33,000 lb.

Train "X"

Train "Xplorer" is equipped with a dual brake system designated as the LWE equipment. This equipment was designed to be operated in segregated service only. It cannot be operated as an automatic brake coupled to existing conventional equipment, and cannot be used to control cars with conventional automatic brake equipment because it has no trainline brake pipe through which conventional automatic brake operation is accomplished.

An electropneumatic straight-air brake system is the basic control with a fully automatic brake system for conductor's valve brake application, simple train-stop functions, and break-in-two protection. Its automatic brake system also may be used as a protection in the event of failure of the electropneumatic system.

The electropneumatic straight-air brake system is built around a small-diameter trainline straight-air pipe (the term "straight-air pipe" designates a control or actuating pipe that is free of air pressure during release of the brakes and has air pressure during brake applications). It consists of a self-lapping brake valve with a control pipe connected to a master relay valve. This valve actuates a circuit breaker, the contacts of which energize or de-energize the trainlined electric circuits and coils of magnet valves throughout the train. These magnet valves function to admit a local supply of air to, or exhaust air from, the straight-air pipe which controls relay valves that admit air to, or exhaust air from, brake cylinders throughout the train. This type of system, incorporating a combination of small-diameter trainline straight-air pipes to be charged from local sources of air supply under control of electrically operated magnet valves throughout the train, produces rapid and flexible brake operation.

In the event of an electrical-system failure, the pneumatic-relay portion of the master relay valve and circuit breaker on the propulsion unit is actuated by the pressure differential thus created. This automatically and promptly admits or exhausts air from the trainline straight-air pipe to accomplish the straight-air pipe functions. Although subject to pneumatic lag caused by the feeding of a small-diameter trainline straight-air pipe from one end only, the resulting brake application will be substantially of the same degree that would have been obtained with the electrical system.

The fully automatic brake system depends upon a trainlined supervisory line which is used during electropneumatic straight-air brake operations to supply air to the car-supply reservoirs and to keep them constantly charged. Full automatic brake operation, initiated by conductor's valve or train-control devices, is accom-

plished by exhausting the supervisory line. . Break-in-two protection also is accomplished by the breaking and exhausting of the supervisory line. A full automatic brake operation also can be accomplished at the brake valve by moving the brake-valve handle to its extreme right-hand position whereby the supervisory line pressure is depleted through a large capacity valve to atmosphere.

The necessary devices to provide an adequate towing brake have been included in the locomotive brake system for dead-heading the train in event of a motive-power failure. The towing brake consists of a triple valve and its auxiliary reservoir for actuating the pneumatic straight-air feature of the brake system and the charging of the reservoir from the towing locomotive. The brake pipe of the towing locomotive is connected to the supervisory-line extension by means of a hose and coupling. The supervisory line and its connected reservoirs are then charged from the brake pipe of the towing locomotive. Brake-pipe reductions by the towing locomotive actuate the triple valve on the propulsion unit being towed and supply auxiliary reservoir air to the control pipe which initiates the brake application throughout the train by the straight-air pipe system.

Train "X," as well as the "Jet Rocket," is a semi-articulated type design, Fig. 2. The axle at the end of the car is braked to the degree selected by the air-spring pressure at the end of the car. If the axle is not subjected to the added weight of an adjacent car, a differential relay valve develops brake-cylinder pressure which is 60 per cent of the control-pipe pressure at the relay valve. If the axle is subjected to the added weight of a coupled car, the developed brake-cylinder pressure is 100 per cent of the control-pipe pressure.

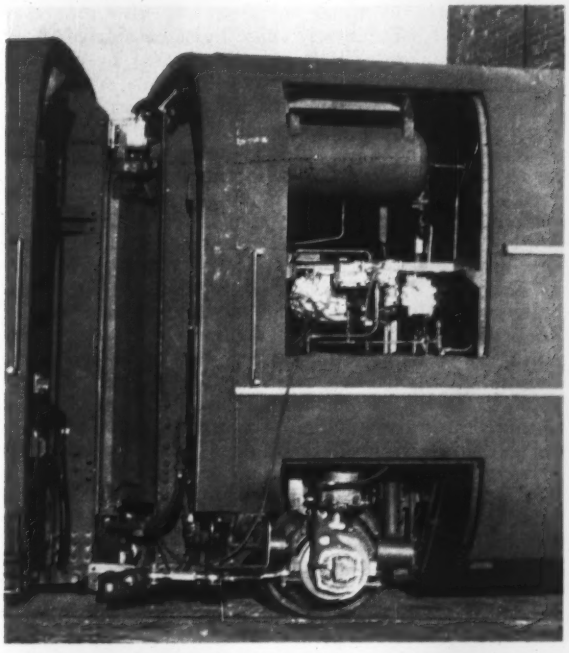

Fig. 2 The "Jet Rocket" is a semiarticulated design. The axle at the end of the car is braked to the degree selected by the air-spring pressure at the end of the car, and compensates for the weight of the adjacent car.

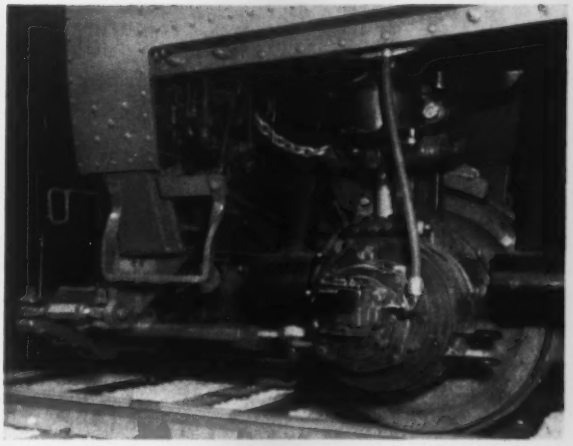

Fig. 3 Train "X" is equipped with 7 × 3 1/2-in. brake cylinders which provide 50-psi service pressure and 80-psi emergency pressure

Train "X" is equipped with 7-in. × 3 1/2-in. brake cylinders, Fig. 3, which provide 50-psi service pressure and 80-psi emergency pressure. The supervisory line is set at 110 psi to develop the maximum brake-cylinder pressure mentioned above. Wheel loads of these cars are 15,150 lb on the heavy axle and 10,660 lb on the light axle, with a brake-shoe force of 4320 lb on the heavy axles and 2600 lb on the light axles during maximum braking.

The locomotive of Train "X" has a wheel load of 29,400 lb on the heavy (power) axles and 20,000 lb on the light or trailing axles. A brake-shoe force of 3460 lb is developed on the heavy axles and of 2260 lb on the light axles, in the clasp-brake arrangement.

Aerotrain

The air-brake system, as developed by Electro-Motive Corporation for use on the Aerotrain cars, is similar in principle to the vacuum-brake system used in many foreign countries, but differs in that air pressure is used in place of vacuum. The valvular components are, therefore, of a pressure design. The control portion and brake rigging are integrated and interdependent upon each other. This arrangement is essentially a straight-air brake with variations that permit the operation of two to twelve cars in multiple service. As in previously described equipment, break-in-two protection is provided in the event of train parting.

Air is supplied to the car at 100 psi through a 1 1/4-in. supply line to a reverse relay, limit valve, relay valve, and to the conductor's valve and the back-up valve. The reverse relay regulates air to a cylinder through a spring-loaded check valve and volume reservoir, providing a predetermined pressure based on the retarding rate desired.

This cylinder is considered the application chamber. A second cylinder of the same area and opposed in direction to the application cylinder is charged to line pressure to release the brakes. The lever arm for the application

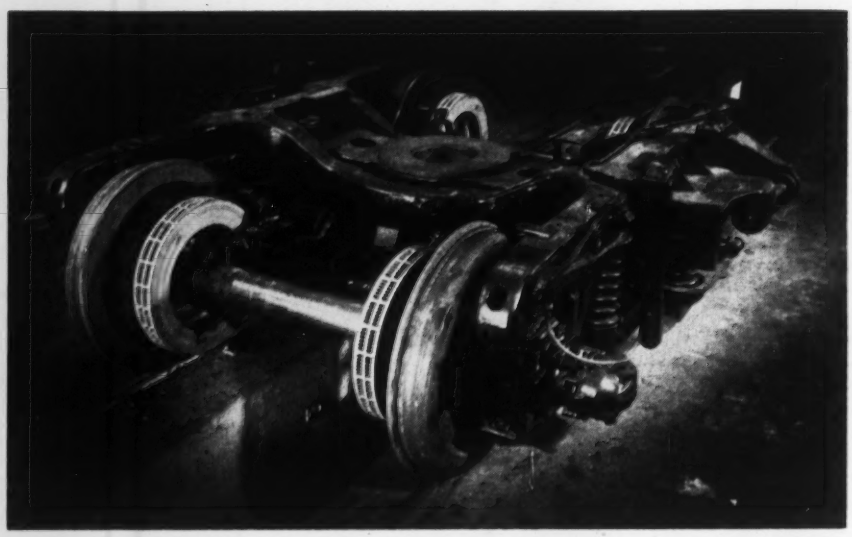

Fig. 5 The "Tubular Train" brake equipment is similar to those previously described, as far as valvular parts are concerned, but the brake action is different, employing standard model "CF" Budd disk brakes

cylinder is slightly less than that of the release cylinder to insure a release of the brakes upon recharge of the system.

When air is removed from the line by the control handle in the locomotive cab, air pressure is decreased in the release cylinder. The application piston then moves toward applied position an amount proportional to the reduction initiated. Thus the force on the shoes can be graduated "on" or "off," as required.

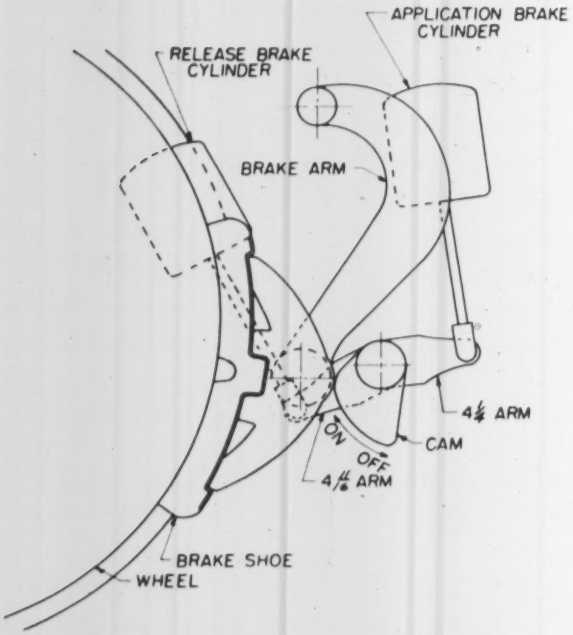

Fig. 4 The brake rigging on the Aerotrain car consists of a nonmetallic brake block with suitable linkage between the opposing application and release cylinders

The brake rigging consists of a nonmetallic brake block with suitable linkage between two opposing cylinders. The application cylinder applies the brakes and the release cylinder, through a slightly longer lever arm, overcomes the force of the application cylinder, effecting a brake release. This arrangement provides pneumatic cushioning of the brake rigging in release and all intermediate points up to full application. This arrangement is shown in Fig. 4.

Many components of the locomotive equipment are standard items to other installations; therefore this description will cover only those items considered to be new developments which are not covered by existing publications.

There are three principal circuits in this arrangement: The straight-air line, the supply line, and the conventional signal line. The straight-air line operates from 0 psi to approximately 20 psi in the service range, and from 16 psi to 24 psi when moving from service to full application. A straight-air application of 20 psi will develop 60 psi effective brake-cylinder pressure in 3 to 5 sec on the train, and 45 psi on the locomotive.

The first or straight-air line is controlled by the S-26 brake valve, as used in the equipment on the "Jet Rocket" train. The handle of this valve controls a reducing valve which pilots a large-capacity relay valve. This relay supplies a straight-air line during a brake application through a cut-off relay. The cut-off relay assures that brake-cylinder pressure will be developed on the locomotive from application made at the conductor's valve or back-up valve in the train. In full application position, the straight-air pressure is increased to full value and a vent valve opens, resulting in the loss of the supply-line pressure. The loss of pressure operates the break-in-two feature of the locomotive and each car.

The second or supply line is fed from the No. 2 main reservoir through a feed valve set at 100 psi. Regulated pressure is furnished to the supply line through an application valve. This valve also acts to cut off the pressure and vent the supply line in the event of a full application of the brake valve or an emergency-valve application

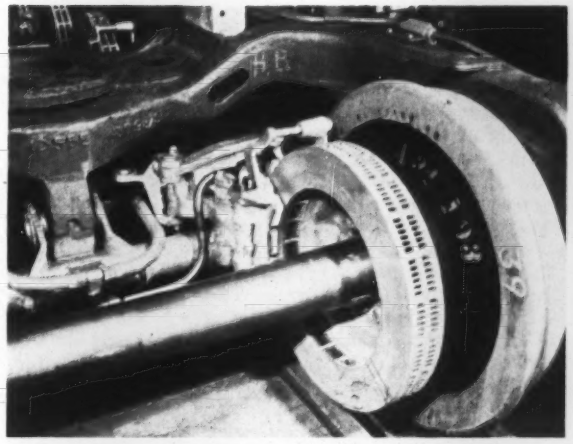

Fig. 6 The standard "CF" Budd disk brake used with the "Tubular Train" brake equipment showing the assembly on the axle mounted inboard of the wheel. A complete carriage is shown in Fig. 5.

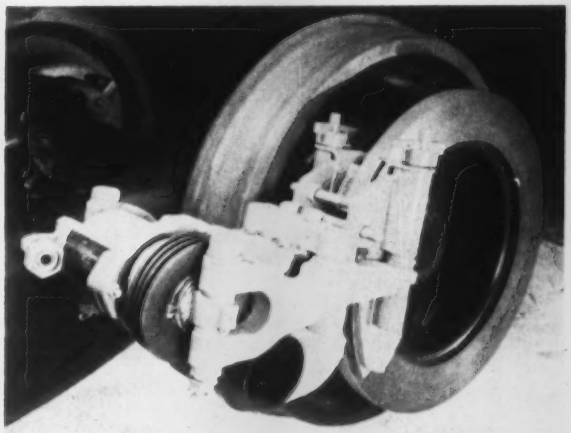

Fig. 7 The "Pioneer III" is equipped with LWE brake equipment. Disk brakes of different design from that of the "CF" Budd are mounted on a tube welded to the truck side member and outboard of the wheels.

from the fireman's position. The supply line furnishes air to the train brake system until 75 psi is reached. Above 75 psi, air is furnished to charge the ride-control system.

Provision has been made on the locomotive for shipment of the locomotive and cars dead in a train. This permits the automatic brake valve of the hauling locomotive to control the braking on the train. Uniform braking force exists on the locomotive and cars; therefore an independent brake is not provided. A parking brake for holding the locomotive has been provided, and is used when making standing brake tests.

Tubular Trains

The "Tubular Train" brake equipment, as far as valvular parts are concerned, is similar to those previously described. The brake action is different in that the standard model "CF" Budd disk brakes are used, Figs. 5 and 6.

The cars of this train have a ready-to-run weight of 88,300 lb and a fully loaded weight of 100,600 lb. The wheel load based on fully loaded weight is 12,575 lb. With an operating pressure of 110 psi brake pipe, brake-cylinder pressures of 36 psi in service and 60 psi in emergency are developed. With 60-psi brake-cylinder pressure a retarding rate of 2.65 mph per sec is accomplished based on fully loaded weight; a retarding rate of 2.85 mph per sec is accomplished based on ready-to-run weights.

Pioneer III

The most recent development in ultra-lightweight passenger trains is the "Pioneer III" designed and built by the Budd Company.

Since the Pioneer III is equipped with LWE brake equipment, a description is not necessary.

Cars of this train have a fully loaded weight of 66,580 lb resulting in a wheel load of 8,322 lb. The braking level is set at, but not limited to, 2 mph per sec and is maintained, regardless of the weight of the car, within certain limits. This is accomplished by control of the brake-cylinder pressure in connection with the constant leveling device incorporated in the air spring.

Again, disk brakes are employed but of an entirely different design. The brake is mounted on a tube welded to the truck side member (wheel piece) and outboard of the wheels, Fig. 7. A solid 23-in. nonventilated disk is bolted to the wheel plate, Fig. 8. Cylinders are cast-alloy aluminum, 4 in. in diam, and weigh approximately 12 lb. The brake-pipe or supervisory-line operating pressure is set at 110 psi. Service and emergency brake-cylinder pressures will be the maximum determined by the weight of the car as already described.

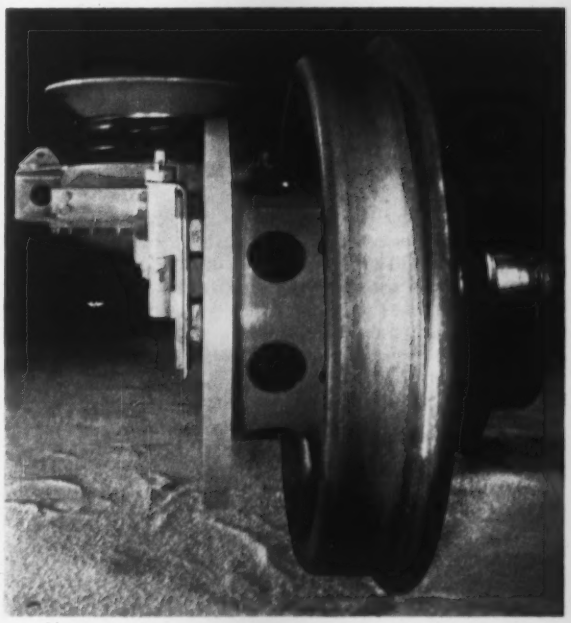

Fig. 8 A solid nonventilated 23-in. disk is bolted to the wheel plate as part of the "Pioneer III" brake equipment

The reasons for Establishing Euratom[1]

By Franz Etzel,[2] Vice-President,
European Community for Coal and Steel

The Euratom treaty signed in March established a European atomic energy commission to supply six countries with nuclear fuel; to carry out stringent inspection; and to frame international agreements

On the eve of the second World War, the six nations with which we are particularly concerned—Belgium, France, Western Germany, Italy, Luxembourg, and the Netherlands—imported only a very small percentage of their total energy requirements—5 per cent. When recovery in Europe started, thanks to the Marshall Plan, import requirements began to rise steeply. At first, it was generally thought that this development was only a temporary one; but in the early 1950's it became clear that the increase in power production in Europe was lagging far behind the increase in industrial and agricultural production, and that dual demand was therefore rapidly outrunning the European fuel supply. Today, the six countries together, which once supplied large parts of the world with energy,[3] are importing 25 per cent of their total energy requirement, that is, the equivalent of 100 million tons of coal.

Economists of the European Coal and Steel Community have made thoroughgoing studies of the relationship between the increase in national product and the increase in energy consumption, estimated for the next twenty years at 3.5 to 4 per cent per annum—considerably less than it has actually been since the end of World War II. It seems obvious that Europe will go on increasing its national product, at least on this modest level.

Allowing for a maximum increase in supplies of coal, oil, gas, and hydroelectricity, European energy *imports* will rise, assuming the increase in national product of 3.5 to 4 per cent, to an equivalent of 200 million tons of coal, or 35 per cent of total consumption, by 1965; and to the equivalent of 300 million tons of coal, or 45 per cent, by 1975. This development poses serious economic and political problems. Let us look at the economic problems first: Power produced in Europe already is considerably more expensive than power produced in the United States.

The difference is mainly due to the geological differences between American and European coal fields. For instance, European coal producers have been forced to exploit marginal coal veins, which would be regarded in America as hopelessly uneconomic. The difference between American and European power prices is even more striking when we examine the part of Europe's energy requirements which must be imported. The same coal which costs 4 to 6 dollars a ton at American pitheads, costs 20 to 22 dollars in our countries after the shipping charges have been added. The cost of power is thus becoming more and more a limiting factor to the growth of Europe's economic strength.

If no new sources of energy are added to the sources now existing in Europe, its fuel import bill, already at $2 billion a year, will rise to 4 billions in 1965 and 6 billions in 1975. This will put a heavy and possibly unbearable strain on Europe's balance of payments. The six nations will have to pay this sum with increased exports of finished products because, as you well know, Europe has no raw materials to speak of which it could use in order to pay for imported fuel.

No doubt, added imports of that magnitude would have a very adverse influence on our terms of trade. However, provided that the bulk of these imports were American coal, and as long as Europe could earn the dollars needed to pay the bill, our supply of power would be assured. But the development of comparable prices for coal and oil, and the fact that demand in Europe, as in the United States, is for more and more oil, make it probable that the bulk of energy imports Europe will need will be covered not by American coal, but by Middle East oil.

Importance of Middle East Oil

Even after the Suez difficulties it seems desirable for Europe to import Middle East oil because of the immense advantage, both to the still underdeveloped oil-producing countries of the Middle East and to Europe. But, as has often been stressed, oil must remain a commodity and not become a weapon. Europe must keep its oil imports from so volatile a region as the Middle East, within manageable proportions. The closing of the Suez Canal and of certain pipelines leading toward the Mediterranean posed great problems. Thanks to the help of other oil producers, the economic machinery of Europe was not seriously slowed. But if Europe's dependence on Middle East oil increases, Europe's economy could be brought to a standstill by halting the flow of fuel from this region.

Peaceful relations between Europe and the Middle East, and even world peace, would be in peril if we let

[1] Based on a message telegraphed from Luxembourg and delivered at the All-Congress Banquet, Philadelphia, Pa., March 13, 1957, of the 1957 Nuclear Congress, by Alfred Iddles, Fellow ASME, and president, Atomic Industrial Forum, Inc., New York, N. Y.

[2] Mr. Etzel, Louis Armand of France, and Francesco Giordani of Italy were appointed by the foreign ministers of the six Euratom countries—Belgium, France, Western Germany, Italy, Luxembourg, and the Netherlands—to study Europe's shortage of energy and make recommendations for nuclear power development.

[3] In 1870, the total world energy production was 185 million tons of coal. From these 185 million tons, England produced 112, or two thirds; 44 were produced by our six countries; 30, or 15 per cent, were produced by the U. S.

a situation develop which gives over the European economy into the hands of one region of the world. Europe must take necessary measures to avoid the birth of a new kind of colonialism, that of Europe as an economic dependent of the Middle East.

These are the political and economic dangers inherent in the European power supply situation. These are the major reasons why we undertook to study Europe's energy problem, and to learn if the production of nuclear power would provide a solution. Our target is not to make Europe self-sufficient in power production, but to stabilize, as soon as possible, Europe's growing fuel imports.

It happens that the rise in total energy imports is about equal to imports of coal and oil that are needed to keep pace with growing demands for electricity. Therefore we have, for the time being, concentrated upon the possibility of substituting nuclear power stations for the construction of new oil and coal-fired power stations.

Europe's energy needs will, in any case, go on increasing during the next four to five years. Even if our nations decide upon a crash program for the development of nuclear energy, it would take at least four or five years before atomic power stations could come into operation. Therefore we have taken as a target the stabilization of Europe's import level by the early 1960's. We, then, have considered how much nuclear electricity should be produced within the Euratom countries during that period. Our energy imports by the end of 1962 will be at a level of 160 to 170 million tons of coal, equivalent to about 30 per cent of Europe's total energy requirements. Thus to reach our target, that is, to stabilize our imports at the 1962 level, we must commission nuclear power stations with an installed capacity of 15 million kilowatts by the end of 1967. Not all new installed capacity requirements in this period would be nuclear. In fact, the total capacity to be commissioned at the same time will be 24 million kilowatts.

Attainability of the Goal

How we found our target has been explained. Our second task was to find out if this goal was attainable. It soon became clear that efforts undertaken on a national scale could not meet the timetable we had set. The establishment of Euratom to pool the scientific and industrial resources of our six nations was obviously the first prerequisite to the realization of our program. Europe's political and economic fragmentation, and the war and its aftermath, have put Europe far behind the United States, Canada, and the United Kingdom in the development of nuclear energy for peaceful purposes—despite the fact that Europe's scientists laid the foundation for the development of nuclear energy.

It is Euratom's task to set up and provide the framework into which private industry will bring life and growth. Euratom is not the agency which is going to order atomic plants. This is purely a job for private industry. But it is our Committee's task to prove that a quick start is needed, and it is Euratom's task to make this quick start possible for private industry. Since we urgently need a quick start, we need the help of those countries who are ahead of us, particularly the United States. We need the help of the United States in two extremely important fields. In the first place, our countries produce only small quantities of natural uranium and no enriched uranium. Because we will want to base at least an important part of our program on reactors requiring enriched uranium, we can do it only if we can be sure of a supply from the United States during the crucial early years. Indeed, the possibility of starting with imported U-235 makes particular sense in our immediate circumstances. Power is too scarce and costly to make U-235 on a large scale in Europe—at least until it becomes amply clear that isotopic separation will be a vital and lasting component process of nuclear power production. Of course, we do not know what the final, cheapest, and best solution will be for producing power in our six countries. Therefore we are also greatly interested in the work being done in the United Kingdom and in Canada in the use of natural uranium.

Encouragement From Washington

During our fortnight's visit in the United States, strong encouragement and support for our objectives came from all quarters. President Eisenhower greatly impressed us with his knowledge of our problems in building a United States of Europe. We came away realizing that he shares with us a deep conviction of the importance of our present work.

The communiqué which was issued following our visit in Washington by Mr. Dulles, Mr. Lewis Strauss, and our Committee, testified to the high degree of agreement we found in our talks with your Secretary of State and the Chairman of the Atomic Energy Commission, and the view that our Euratom goal for nuclear power development is entirely a feasible one. Our later talks in Canada and in the United Kingdom closely confirmed this general conclusion.

A second conclusion reached in Washington that the availability of nuclear fuels will not be a limiting factor to our program has been very heartening to us. Just as important has been the readiness shown by the AEC to offer the services of its own experts to examine with us the technical problems posed by our objective, and the probability that a task force composed of their most able technicians will be placed at the disposal of the new organization.

The great difference in the cost of energy between Europe and the United States has been pointed out. In Europe, electricity produced in new conventional power plants based on imported energy now costs 10 to 12 mills, compared to 6 to 7 mills in most parts of the United States. Considering also that all new thermal stations in Europe will have to burn imported fuel, the difference in the cost of electricity means that atomic power will be economic in Europe long before it is in the United States. The amount of research and development work going on in your country, both through the AEC and through private industry, is extremely impressive. But the stage of large-scale industrial application of this immense potential still seems five to ten years off. Europe, however, needs atomic power on a large scale right now. Within the framework of Euratom, Europe could start very soon in the building of large nuclear power plants with several reactors of optimum unit capacity on each site. The reactors would include most of the types that are available today for commercial application. This program would provide an invaluable opportunity to

(Continued on page 575)

SHELL CASTINGS

Typical examples of their applications

By H. G. Sieggreen

Chief Engineer, Central Foundry Division,
General Motors Corporation, Saginaw, Mich.

SHELL molding is a relatively new process of making castings which is now being used extensively by the foundry industry. Most of its development has taken place since the end of World War II. The process derives its name from the physical nature of the mold which is a shell or wafer of sand bonded by phenolic resin into which the metal is poured. See Fig. 1.

Shell Molding and Casting Procedure

The shell is made from a mixture of dry sand and powdered thermosetting phenolic resin. This mixture is applied to a hot metal pattern (425–450 F) and left for a period of time depending on thickness desired, usually 20 to 60 sec. The heat melts the resin, which flows between the grains of sand and to the pattern surface. The excess material is then removed by dumping, and the pattern plus the soft invested shell are put in an oven and cured until hard, usually 30 to 60 sec at 1050 to 1200 F. Curing of the shell on the pattern produces a hard, smooth mold which is just as accurate as the pattern itself. The pattern and shell are then removed from the oven, and the shell is stripped from the pattern by ejector pins in a manner similar to the removal of a die casting from the die cavity. The process is shown schematically in Fig. 2.

The shell, although warm, is actually ready for use. Of course, iron cannot be poured until the two halves of the shell are assembled.

All production shells are poured in a horizontal position. The castings are shaken out after the required cooling time with comparable ease facilitated by the burning out of the resin bonding material.

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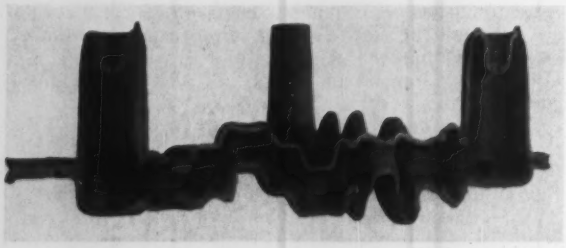


Fig. 1 Section through an assembled shell mold. Shell thickness varies from $^{3}/_{16}$ in. to approximately $^{9}/_{16}$ in., depending upon physical characteristics of the casting and type of metal being poured.

Advantages of Shell Molding

This process is particularly advantageous for quick and simple production of complicated molds such as those requiring narrow and accurate passages and cross-section. It is practically impossible to produce certain parts in any other way without prohibitive costs. This is especially true of ferrous metals.

Another major advantage of the shell-mold process is the reduction in the number of subsequent machining operations required to complete a part. The dimensional tolerances and surface finish obtainable in making parts by the shell-mold process eliminate in many cases the need for machining on all except the wear and contact surfaces. Surface finish is such that fine engraving can be duplicated and 250 to 300 microin. surface finish can be attained under controlled conditions. On some parts where contoured areas formerly required profile milling, shell castings have eliminated the need for this costly machining operation. For example, prior to the advent of shell molding, the trigger housing of the Browning automatic rifle, Fig. 3, was machined all

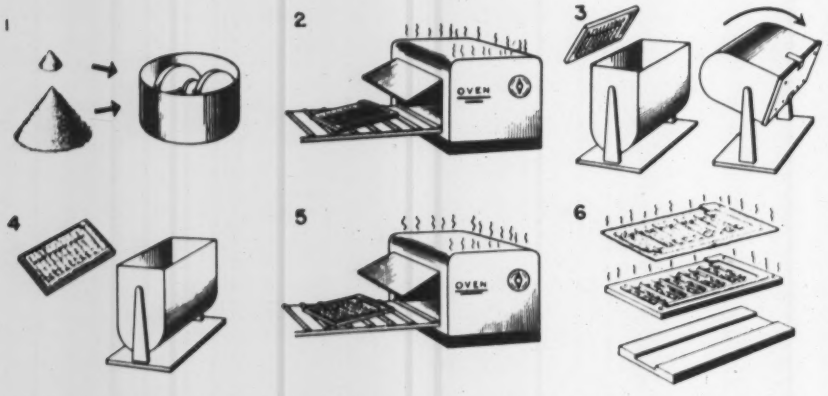


Fig. 2 Six basic steps in making a shell mold: (1) material mixing, (2) pattern heating, (3) shell investment, (4) removing pattern and invested shell from dump box, (5) curing the shell, and (6) stripping shell from pattern

over. Even when machining is necessary, over-all casting accuracy permits the use of minimum finish stock. This eliminates the need for roughing cuts on most surfaces; and in some cases, only a grinding operation is required.

Although the improved casting accuracy obtainable in shell castings generally results in elimination of some machining operations, it is sometimes more practical to machine all over. Here, again, the more accurate shell-molded castings allow for less machining stock and more positive chucking. Furthermore, a cleaner casting surface permits higher cutting speeds, increased production, and lower tool costs through increased tool life. Less metal to remove in chips means lower freight charges because of a lighter casting.

Examples of Production-Type Shell Castings

Governor Body and Bushing (Fig. 4). These parts for an automatic transmission were formerly made of aluminum die castings, but the steel piston rings used in conjunction with the aluminum governor body caused excessive wear in the ring grooves. It had not been possible in the past to cast these parts in gray iron because of the difficult coring involved. However, shell molding has made this a relatively simple job to cast, and several million of each part have now been produced.

Of special note is that a hole is cored completely through the larger casting. The portion of the grooves cast by the core must be in perfect alignment with that made by the cope shell. The minor diameter of the core is $^{5}/_{16}$ in.; and this diameter, machined to $^{3}/_{8}$ in. by the casting user, obviously allows very little for casting or machining errors.

Valve Body (Fig. 5). Complicated parts such as this are easily cast in gray iron. The part was considered as an aluminum die casting, but this was thought unsatisfactory because of adverse expansion and wear characteristics. Meeting the requirements for very close tolerances on the thickness and location of ports was made possible by the shell process.

Adjuster Nut (Fig. 6). This is a good example of casting improvement by converting from green-sand to shell molding. In the original design, heavy-section thicknesses exceeded strength requirements of the part, but green-sand molding considerations did not permit further lightening of the casting. Draft angles on this green-sand design varied from 2 deg to as much as 10 deg. Further lightening of the part could be accomplished only through the use of cores. The shell-process version uses draft angles of one deg or less and has deeper pockets in the areas where excess metal previously existed.

Automotive Camshaft (Fig. 7). Among the advantages of shell-molded camshafts are these: (1) better dimensional control for automatic handling; (2) better tool life due to absence of burned-in sand; and (3) cleaner side surfaces on cam lobes, providing freedom from ragged edges.

Flange Yoke (Fig. 8). This part has recently replaced a forging of similar design. On the forging, machining operations on the body portion were necessary to provide a balanced part and also to provide clearance for the four bolt holes. The close dimensional control and small draft angles on the shell castings made these operations unnecessary. Because this area does not

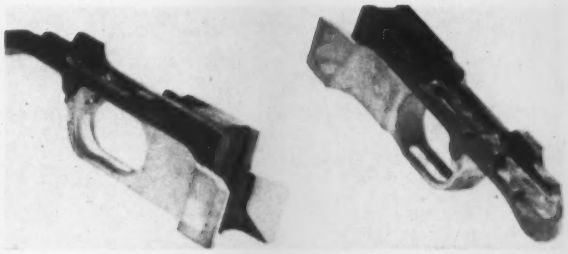


Fig. 3 Trigger housing of shell-molded Browning automatic rifle. The only machining required is on the wearing surfaces indicated by dark paint.

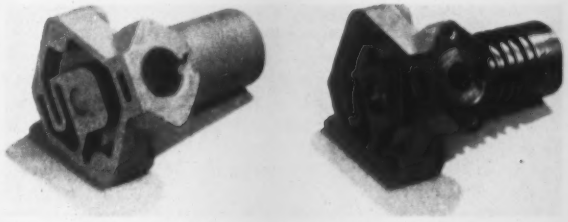


Fig. 4 Governor body casting (*left*) and the same casting machined with a bushing in place (*right*). The nominal machining stock allowance on these two parts is $^{1}/_{32}$ in., and in some areas it is even less.

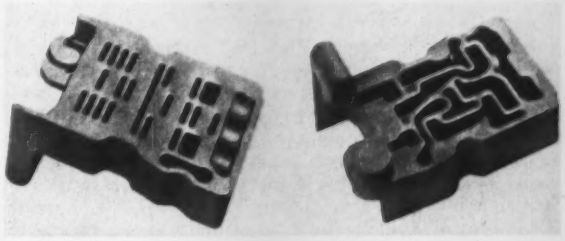


Fig. 5 Valve body for the automatic transmission of a military vehicle. A dimensional tolerance of ±0.005 in./in. is conventional for small shell castings.

Fig. 6 Adjuster nut for conventional steering. In this shell-process version the weight has been considerably reduced from the earlier design for a sand casting, machining stock is less, and the hexagonal portion is more accurate for wrench application.

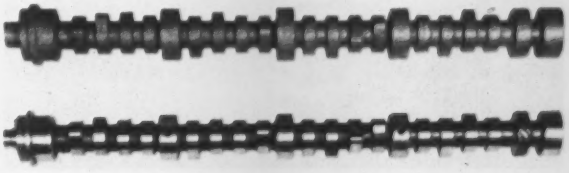


Fig. 7 Shell-molded automotive camshaft notable for less scrap than conventional molds in both the machine shop and the foundry, shown here before and after machining

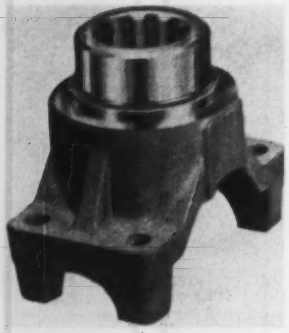


Fig. 8 Shell-molded ArmaSteel flange yoke used on an automotive propeller shaft. This casting eliminates machining on the outside and inside surfaces of the body portion.

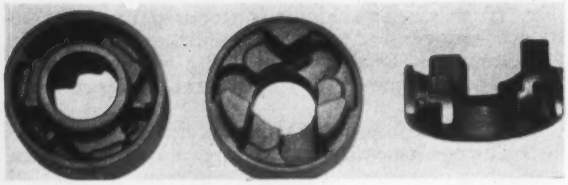


Fig. 9 Automatic automotive transmission drum. Produced by the shell process, it offers a wider latitude of design than drums made by other methods.

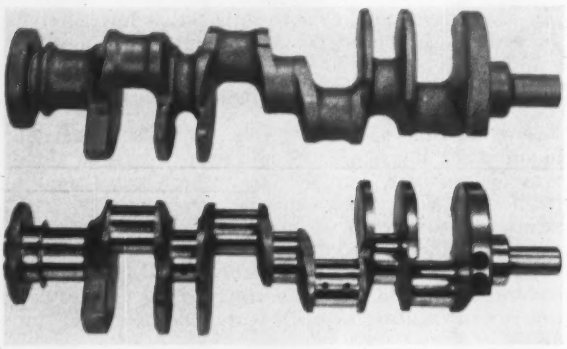


Fig. 10 Automotive crankshaft molded by the shell process. Top view shows shell-molded ArmaSteel casting before machining; weight, 64 lb. Bottom view shows machined shell-molded ArmaSteel casting; weight, 54 lb.

require machining, it was possible to incorporate ribs which greatly increase the fatigue life of the part. Other advantages of the shell castings are: (1) virtual elimination of pattern-shift problems; (2) a hole is provided through the splined tube without the use of a core; (3) sharper detail and well-filled-out corners and edges; and (4) increased tool life, resulting in less down-time for tool changes.

Transmission Drum (Fig. 9). In this application, machining on clearance dimensions has been eliminated, and balance drilling has been greatly reduced. The conversion of this part from green-sand molding to shell molding was justified on the basis of machine savings alone. Further, freedom from surface sand is important because the part operates in a hydraulic medium.

Automotive Crankshaft (Fig. 10). The production of automotive crankshafts by the shell process has permitted car manufacturers to increase maximum horsepower through increasing piston size and length of stroke without major changes in any of the other engine parts. This has proved to be a great advantage to engine designers when dealing with problems caused by the restricted space in the crankcase area. These modifications result in greater rotating and reciprocating forces which, in the new and modern V-8 engine, must be balanced by larger counterweights. Now the problem is solved with relative ease, for the shell-molding process allows considerably greater latitude in design of the counterweights.

With a shell-cast crankshaft, it is now possible to flare the counterweights to any desired width (end surfaces can be practically perpendicular to the pattern parting) to achieve the maximum balancing effect. Radii of counterweight tips can be consistently cast as low as $^1/_8$ in. (In other methods of producing crankshafts, the variation on the tips or corners was so great that a 1-in. radius was usually specified.) Shell-cast crankshafts are produced with extremely narrow spaces between the counterweights, inasmuch as the drawing of deep and narrow pockets of this nature is now quite practical. Another advantage is that draft angles of less than $^1/_2$ deg are commonly used. All these factors make it feasible to produce the eight counterweight shafts, which many engineers favor because of their ability to decrease crankshaft deflection and main-bearing loads. With shell-cast ArmaSteel (pearlitic malleable iron), crankshafts can now be made even for the extremely difficult V-6 engine.

From the standpoint of machining, the new shell-cast ArmaSteel crankshafts present substantial savings. On some designs, it is possible to eliminate the cheeking on the sides and the turning operations on the outside diameters of the counterweights. When these machining operations are necessary to attain maximum counterweight thickness and diameter, only a minimum of stock need be removed.

The good dimensional control of shell-cast crankshafts, over long production runs, provides for consistent balance drilling and has permitted the removal of 44 per cent of the machining stock required on the forging previously used. This dimensional control is due to the negligible pattern wear and the hard, smooth, accurate mold. By using accurately machined patterns, with crankpins positioned, the completed castings provide excellent crankpin index.

Conclusions

Shell castings generally are slightly more costly than conventional green-sand castings, mainly because of the phenolic resin used as a mold binder. Considerable research work is under way to develop new and less expensive binders which will put shell castings in a better competitive position. Even at the present resin cost, some castings can be produced at a cost comparable to, or lower than, green-sand castings. This is particularly true when cores can be eliminated.

Although the majority of castings produced today are made by the conventional or green-sand method, many shell-molded parts have invaded the automotive field. Progress during recent years rates the process as one of the greatest foundry developments of modern times. The time may come when it will be more economical to produce most small castings by this method.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Editor*

Package Power Reactor

THE Army Package Power Reactor, APPR, a 10-power-megawatt 2035-electrical-kw pressurized-water nuclear-electrical-generating-plant demonstration facility built by Alco Products, Inc., was dedicated at Fort Belvoir, Va., April 29, 1957. The APPR is the prototype for a standard facility developed jointly by the Army and the Atomic Energy Commission. The components can be transported by air and erected at a remote field site in a 6-month construction period.

It is one of a family of nuclear power plants being developed by the Army to meet all nuclear power needs of the armed services except ship and aircraft propulsion which are covered in another program. The larger plants will be semipermanent installations for use in areas where fuel supply is difficult, costly, or vulnerable to interruption by enemy action. They will be capable of operating up to $1\frac{1}{2}$ yr with a single fueling weighing only a few hundred pounds. By contrast, an equivalent conventional plant would require 60,000 bbl of fuel oil, a full load for a relatively large tanker. Smaller plants will be mobile or semimobile and intended for the support of military operations or emergency power requirements.

Alco Products, Inc., is also developing an entirely civilian plant based on the APPR concept with about $\frac{1}{10}$ of the power. Construction has begun on a prototype plant which will be of the boiling-water-reactor type.

Two other major projects now under way in the Army program, are a gas-cooled reactor experiment, and a closed-cycle gas-turbine facility. Special-purpose nuclear-reactor systems under the program include nuclear propulsion for overland cargo carriers, and a gamma-radiation source for food-preservation activities of the Army Quartermaster Corps.

The reactor recently dedicated at Fort Belvoir will provide cost information, operating parameters, and engineering test data. It will serve as a training facility for troops and the specialists who will operate and service the remote plants. A staff of 42 is required for start-up, and 29 are required for normal operation.

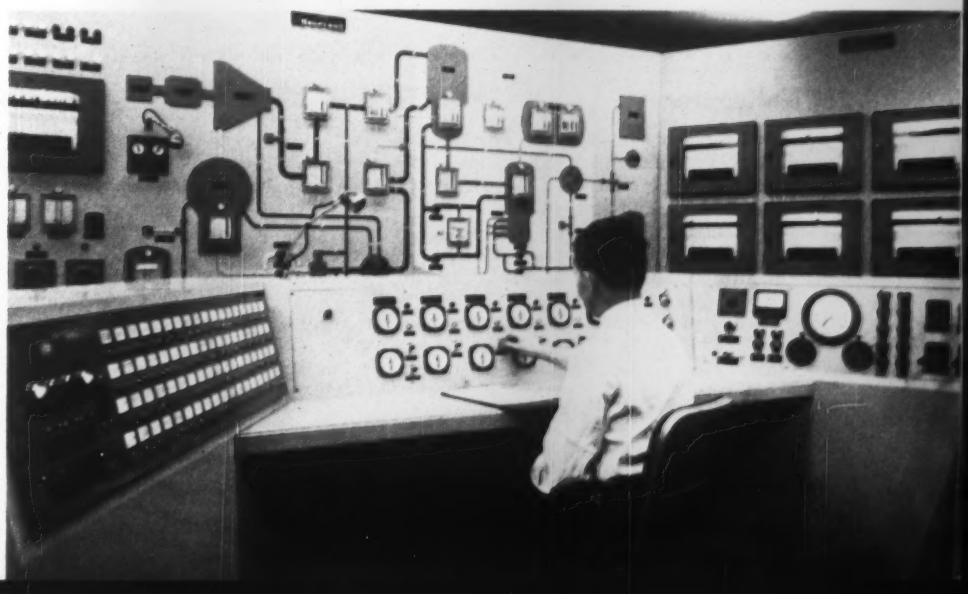
The core consists of fully enriched uranium-dioxide fuel in 38 fuel rods arranged with 7 control rods in a 7×7 basic-grid structure which lacks the four corner squares. Each fuel assembly consists of 18 fuel plates brazed into a pair of 304-L stainless-steel plates 27 in. long, 2.863 in. wide, and 0.050 in. thick. Each of the seven identical control rods is constructed in two segments.

The upper segment, contains boron-10 isotope in a matrix clad with stainless steel, and resides in a lattice when the rod rests in the shock absorbers. The lower segment contains a fuel element with 16 fuel plates, and is raised into the lattice when the control rod is up. The plant is normally operated by five of the rods with the remaining two in the up position.

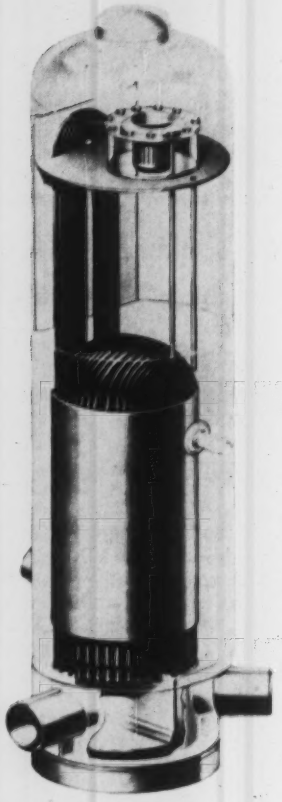
The $47\frac{1}{2}$-in-ID and 162-in-over-all-length reactor vessel is clad with 0.125-in. stainless steel.

The Alco-built steam generator has a U-type tube bundle with tubes 326 $\frac{3}{4}$-in-OD by 0.062-in-wall and total effective heating surface of 836 sq ft. Inside the same shell, separated by a baffle plate, is the superheater section with 194 sq ft of heating surface, making an over-all total of 1030 sq ft for the generator. Type 304-L stainless is the basic corrosion-resistant material in the steam generator, and all piping in the primary system is of $\frac{3}{4}$-in-wall-thickness 12 $\frac{3}{4}$-in-OD solid stainless steel.

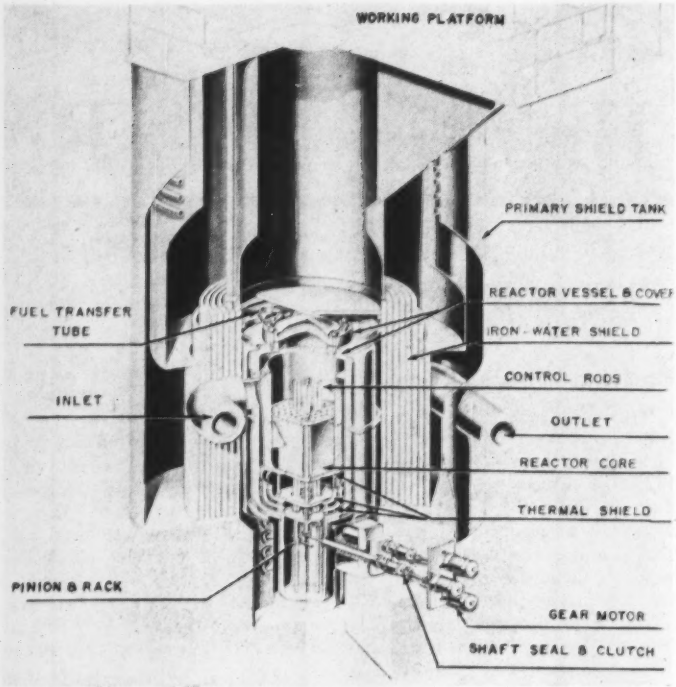
The steam generator receives slightly radioactive water at 450 F from the primary system, while secondary water enters the shell side about halfway up the steam-generating section at a full-load rate of 34,270



The instrumentation console for the APPR has a color-graphic panel which clearly shows all piping, pumps, valves, heat exchangers, tanks, and other parts, enabling the operator to check each component quickly



The Alco-built steam generator has a U-type bundle with 326 tubes and a total effective heating surface of 836 sq ft. The 194-sq-ft superheater section is separated from the generating section by a baffle plate. Slightly radioactive water at 450 F from the reactor is received in the primary system. Secondary water at 250 F enters the shell side about halfway up and is converted to steam by contact with the tube bundle.



Primary shielding for the stainless-steel-clad reactor vessel is a 156-in-diam steel tank filled with water and containing eight concentric 2-in-thick steel cylinders, separated by 1-in-thick layers of water. The innermost cylinder also functions as the inner wall of the tank and acts as a vessel support.

lb per hr, and is converted to steam by contact with the tube bundle. The steam is used to drive the turbine downstream in the secondary side of the plant.

A 190-psia 404-F General Electric turbine drives a GE 2500-kva generator through a reduction gear at 1200 rpm, producing 3-phase 60-cycle current at 4160 volts. Excitation is from a 15-kw direct-connected exciter.

Heat from a steam-bleed point in the turbine is used in one low-pressure Alco feedwater heater operating at 29.9 psia. The 1200-psi operating level of the primary system is maintained by two immersion heaters housed in the 45-in-ID stainless-clad pressurizer which contains sufficient steam and liquid to absorb fluctuations of primary-liquid volume without excessive pressure changes and is mounted on a 16-in-ID × 54-in-long cylinder.

The primary system contains about 1300 gal of water with not more than 2 ppm solid concentration and circulates at about 4000 gpm. Two 42-in-high 12-in-diam General Ionic Corporation demineralizers purify portions of the water removed from the primary loop. Resin and demineralizer units will be periodically removed and discarded as a contamination safeguard.

An iron-water primary shield, chosen because it weighs less than concrete, and is assembled faster, consists of a 156-in-diam steel tank filled with water; and contains eight 2-in-thick concentric steel cylinders separated by inch-thick layers of water. The innermost cylinder functions as the inner wall of the tank and as a support for the pressure vessel.

Reactor, steam generator, and pressurizer are housed in a 32-ft-ID 64-ft-high combination steel and concrete vapor container fabricated by Bethlehem Steel Corporation from $^{7}/_{8}$-in-thick steel ring segments. Additional

Jet Helicopter

Piasecki Aircraft Corporation, Philadelphia, Pa., has an option to manufacture a baby two-seat, jet-powered single-rotor helicopter designed by Fairey Aviation Company, Ltd., Hayes, England.

Intended for a wide range of climates, it operates equally well in tropic or arctic areas, with an automatic deicing of the rotor blades from the hot gases flowing through them.

Easy to fly, and remarkably stable even in hurricane-force winds, it is simple enough to be maintained by its own pilot. Gears, clutches, and shafts are eliminated with a simple means of driving the two-bladed rotor. Direction is given by putting the rudder in the exhaust jet of the engine. The high inertia of the rotor provides an inherent safety in power-off glide, including vertical descent and landing, using the fly-wheel effect of the rotor to check descent.

With an empty weight of 995 lb it cruises at 80 mph and top speed is over 105 mph. Dimensions are only 28 ft $3^{1}/_{2}$ in. rotor diam; 6 ft 3 in. skid track, and over-all dimensions of 15 ft long and 8 ft 2 in. high, less rotor, permit it to be easily loaded onto a truck, ship, or cargo aircraft. The two steel and aluminum rotor blades can be reinstalled in less than 10 minutes.

concrete shielding and protection against explosion hazards are provided.

The Minneapolis-Honeywell instrumentation and controls were designed to take advantage of the strong negative temperature coefficient of the APPR which makes it a very stable system requiring no additional control mechanism to override rapid power excursions.

Basis of the instrumentation and control is measurement of both power level and the rapidity of the increase in power level, providing an anticipation factor. Neutron measurement is achieved with a variety of standard instruments for various power levels. Scram shutdown is effected in the event of either too high a power level or too rapid a rise in power. Control-rod drop begins 60 millisec after the shutdown signal, and 2 per cent negative reactivity will have been introduced 250 millisec after the drop starts.

Modifications from the conceptual design developed by Oak Ridge National Laboratory and described in an article in the November, 1955, issue of MECHANICAL ENGINEERING, are principally the abandonment of the provision for 12 million Btu of steam to be used for heating purposes, and placement of the control-rod drives at the bottom of the reactor to facilitate access to the core for fuel-rod changes and other maintenance.

Nuclear Briefs

▶ Research Stellarator

THE Atomic Energy Commission has approved plans for the design and construction of a large experimental device for research into controlled thermonuclear reactions at the Forrestal Research Center at Princeton University, which has been engaged in controlled-fusion research since 1951 including work with small Stellarator models.

Named the Model C Stellarator, it will not be a pilot plant or prototype of a thermonuclear power plant. It will be exclusively a research tool, making possible experimental work which cannot be performed as effectively with smaller models.

It is expected that construction of facilities to house the device will begin in 1958, subject to Congressional authorization and appropriation, and that experiments with the Stellarator will begin late in 1960 or in 1961.

The Stellarator consists essentially of a hollow tube containing ionized gas. Around the tube are external coils which produce a magnetic field to confine the gas. The objective of the research program is to heat the gas to temperatures of millions of degrees and at the same time to confine the heated gas within the tube for sufficient time to allow fusion reactions to take place.

▶ Submarine Prototype Reactor to Be Shut Down

The AEC will shut down the prototype Submarine Intermediate Reactor, SIR, which was developed at the Knolls Atomic Power Laboratory and has been operating experimentally at West Milton, N. Y., since May, 1955. The reactor plant is the prototype of the nuclear propulsion system of the submarine *Seawolf*. A new project has recently been assigned to the laboratory to develop a pressurized-water nuclear propulsion system for a surface vessel of the destroyer type. In addition, the laboratory is developing a pressurized-water power plant of advance design, the Submarine Advance Reactor, for the submarine *Triton*.

The deactivation of the SIR follows a statement by the Department of Defense that it does not plan to install sodium-cooled reactor-propulsion systems in any other naval vessel and the completion of experiments to develop operating information required in the sea trials of the *Seawolf*.

Plans for the disposal of the reactor and equipment at West Milton, N. Y., are being prepared by the AEC.

▶ Case Industrial Nuclear Center

A high flux engineering test reactor and other nuclear research facilities for the proposed Case Institute of Technology's Industrial Nuclear Center in Cleveland, Ohio, are in the preliminary design stage.

The reactor would be the heart of the $7,000,000 nuclear research, development, and educational center now under study at Case in co-operation with several Northern Ohio industrial firms.

As now conceived, the proposed laboratory would be one of the outstanding nuclear centers to be developed under private auspices in this country. Extensive research and engineering facilities, including gamma-irradiation facilities, "hot" laboratories and caves, radiochemistry laboratory, particle accelerator, neutron spectrometers, and other apparatus would complement the reactor, which would have a flux of approximately 2×10^{14} neutrons per sq cm per sec and a maximum power level of 15,000 to 20,000 kw. The center would include ten or more laboratories for use by private industrial firms participating in the project.

The Ultra-Light jet, one of the world's smallest and simplest helicopters can be maintained by its own pilot, uses economical low-grade fuel, will cost only half the price of current small helicopters. It can operate equally well in arctic or tropic temperatures and withstand hurricane-force winds.

▶ "Test Loops" Aid Atomic Studies

To help speed the development of peacetime atomic power, Westinghouse Electric Corporation engineers have placed into operation two new experimental atomic "test loops" to study the corrosive effects of hot, pressurized fluids on the structural materials in nuclear power plants. They will be devoted to such specialized tasks as developing and testing corrosion inhibitors, corrosion-resistant alloys, and corrosion-resistant joints in structural materials.

The loops were designed to operate up to 2000 psi and 600 F. These conditions, which are similar to those existing in actual atomic power plants, are maintained by a thermal pressurizer and external heaters.

Each loop has two identical test sections which hold up to 105 specimens at a time. A small amount of the fluid is continuously diverted from the loop and circulated through a deionizing loop which removes the corrosion products from the fluid and provides for sampling and tests of purity. They are so arranged that one can be shut down for removal of the specimens without stopping tests in the other.

▶ New Reactor System Development

The AEC has contracted with the Nuclear Development Corporation of America, White Plains, N. Y., for research, development, and preliminary design to demonstrate the feasibility of a liquid-sodium-cooled, heavy-water-moderated reactor system, at an estimated cost of $1,725,000.

The work under this contract looks toward the construction and operation of a 10,000-electrical-kw nuclear plant in Anchorage, Alaska, under a three-party agreement now being negotiated among the Nuclear Development Corporation, the Chugach Electric Association of Anchorage, Alaska, and the AEC.

Although extensive technical knowledge has already been developed on the use of either heavy water or liquid sodium in reactors, a significant amount of research and development is considered necessary to develop technology combining the two in a single reactor system.

▶ The Glenn L. Martin Experimental Facility

The Atomic Energy Commission has filed notice of proposed issuance of a permit to The Glenn L. Martin Company of Baltimore, for construction of a nuclear experiment facility at Middle River, Md.

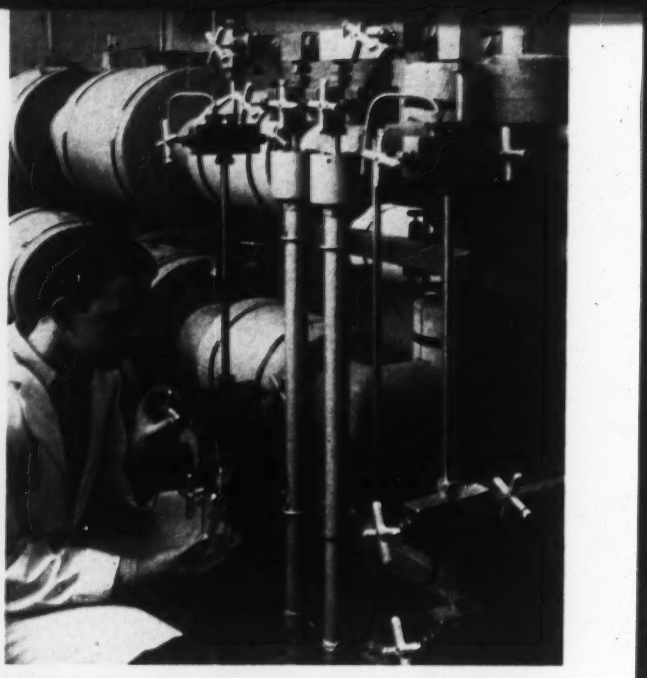
The proposed facility will have two critical experiment cells operating independently of each other. Initial experiments will relate to the Martin Power Reactor, MPR, and to systems similar to the U. S. Army Package Power Reactor, APPR.

In the MPR experiment the reactor type to be investigated is a heterogeneous, water-moderated pressurized system using stainless-steel-clad enriched tubular fuel elements.

Flat-plate fuel elements in the form of foils with stainless-steel plates on both sides will be used in the APPR facility. Water will be used as moderator and reflector.

For each assembly the core will be supported in an aluminum tank in a concrete pit. Test-cell walls and roof will be of monolithic reinforced concrete.

The critical experiments will be conducted at or near zero power. Maximum power will not exceed 10 watts.



The corrosive effects of hot, pressurized fluids on the structural material in nuclear power plants will be tested in two experimental "atomic loops" at the Westinghouse Electric Corporation

▶ Merchant Ship Reactor Contract

The Atomic Energy Commission has awarded The Babcock & Wilcox Company of New York a $9,872,000 contract for the design, development, and fabrication of a nuclear reactor and propulsion-plant components for the first nuclear-powered merchant ship. The ship is being built as a joint project of the AEC and the Maritime Administration of the Department of Commerce.

Under the contract, B & W will design, develop, and fabricate a pressurized-water reactor of an advanced type capable of a continuous output of 20,000 shp. The reactor, which will have stainless-steel-clad uranium fuel elements enriched in U-235 to 2.9 per cent, will power both the ship's propulsion machinery and ship's auxiliaries, such as the electrical generation plants, heating system, and cargo-handling equipment. The contract also covers the steam turbine, reduction gears, and electrical turbogenerators.

▶ Titanium Furnace Controlled With Atomic Radiations

Gamma rays from cobalt-60 have been put to use by Westinghouse Research Laboratories to detect and control the level of molten titanium in a new "cold hearth" arc furnace. The successful operation of the furnace at the Westinghouse metals development plant in Blairsville, Pa., demands exact control of the molten surface of the titanium ingot inside it. The control must be foolproof, precise, and fast-working while the temperature of the white-hot liquid titanium is more than 3000 F.

A small needle of cobalt-60 is placed outside the furnace and in line with the top surface of the ingot. The "hot" cobalt-60 is kept inside a shielded lead "box" with 4-in-thick walls. When a door in the box is opened, a beam of gamma rays passes through the furnace walls and across the top surface of the ingot.

If the ingot inside the furnace is too high, it partly

"Fueling up" the Babcock & Wilcox Company's critical experiment reactor at Lynchburg, Va. Fuel elements containing U-235 and thorium at the lower left, are hoisted from the cart to position in the reactor tank.

blocks the beam of gamma rays, reducing the amount of radiation getting through the furnace to the scintillation counters. If the ingot is too low, the beam is interrupted less by the ingot, and the amount of radiation through the furnace is greater. These changes are used to detect the ingot's position and bring it to its correct level, within 0.01 in. of its ideal operating position.

If, for any reason, the ingot moves beyond its prescribed limits, the gamma-ray control causes immediate shutdown of the furnace.

Although designed expressly for the Westinghouse titanium furnace installed at Blairsville, the gamma-ray control could be used on other types of furnaces and in other position-measuring and leveling applications.

▶ Reactors to Denmark and West Germany

The AEC has filed notice of proposed issuance of licenses for the export of a 5000-kw tank-type and a 500-watt solution-type research reactor to the Danish Atomic Energy Commission in Copenhagen, Denmark, and has issued a license for the export of a research reactor to West Germany.

▶ Critical Experiment Laboratory

Proposed cores for the Consolidated Edison Indian Point, N. Y., nuclear power plant will be studied extensively at the Babcock & Wilcox Company's Critical Experiment Laboratory near Lynchburg, Va., to determine the operating characteristics of the full-scale plant. The experiment and the building which houses it, are the first built entirely at private expense for commercial application.

Fissionable material used in the experiment is U-235, with thorium the "fertile material" for conversion to U-233, and regeneration of the fissionable material, prolonging the life of the reactor core.

Reactor and other components of the nuclear steam generator will be housed in a 190-ft-diam gastight steel sphere.

▶ AEC to Purchase N. Y. Uranium

The AEC has signed a one-year contract with Ramapo Uranium Corporation of New York, N. Y., agreeing to purchase at $8 per lb, uranium oxide, in uranium concentrates produced in a pilot plant operated by the company at Warwick, N. Y. The maximum quantity that may be purchased under the contract is 50,000 lb of U_3O_8.

Atomic Vapor

Atomic vapor, a substance which cannot properly be assigned to the conventional solid-liquid-gas categories, has been produced by using the highest technically useful temperatures yet achieved on a continuous basis at the General Electric Company's Missile and Ordnance Systems Department, Philadelphia, Pa.

Key instrument in producing this substance was a water-stabilized arc in which the arc column is controlled, or stabilized, by a whirling blanket of water. The water gives a "squeezing" effect, forcing the column to stay within prescribed limits and allowing more and more current to flow across the arc points with correspondingly increased temperatures and higher velocities.

The highest verified temperatures measured thus far have been 14,000 K, or 25,660 F. For comparison, the surface temperature of the sun is 6000 K, or 11,260 F.

These temperatures are brought to bear on objects by a plasma jet, flowing at high velocities from the arc through an orifice in one of the electrodes.

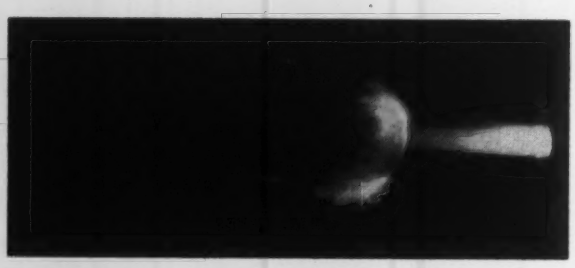
By using air-stabilized arcs, now under development by G-E, velocities of 10,000 fps can be achieved, with the water-stabilized arc, 4000 fps are being reached.

The highest steady-state heat-transfer rates ever achieved are also possible with stabilized arcs. So far, scientists have created 2000 Btu per sec per sq ft about 4 diam from the nozzle. This compares with 800 Btu from rocket-engine nozzles.

The plasma flowing from the arc is in a highly dissociated state, and becomes an atomic vapor, for a complete molecular breakdown occurs. This state is similar to that found in the stars, where temperatures in the millions of degrees are common and is popularly referred to as a fourth state of matter, since it cannot properly be assigned to the conventional solid-liquid-gas categories.

With such high temperatures, velocities, and heat-transfer rates, the arc is very useful for testing materials which may face these conditions.

The arc is a good complement to such other heat-producing equipment as shock tunnels, solar furnaces, and rocket-engine exhaust. The shock tunnel is used to simulate aerodynamic conditions. Its tens of microsecond operation is sufficient to give good flow information, but it does not yield satisfactory information on heat flux. Heat produced by the solar furnace gives information on material behavior at moderately high temperatures, but the atmosphere in the furnace is static, and erosion and ablation studies are impossible. Besides giving much lower temperatures, costs for rocket-engine tests are over



Testing by plasma jet, with arc alone at atmospheric pressure. The water-stabilized arc makes possible temperatures up to 25,660 F, or greater than the 11,260-F temperature of the sun's surface.

ten times those for arc tests, and these extremely high costs make frequent use of rocket tests almost prohibitive.

The arc offers the advantages of a controllable environment, controllable pressure, rapidity and simplicity of operation, sustained testing, safety, and economy. The expense of building an arc is very low; the main expense is the power needed to operate it, since 80 kw are needed to operate the $^1/_4$-in. model, and 3000 kw for the $1^1/_4$-in. model. Present plans call for constructing a 3-in. model which will require 8000 kw.

The stabilized arc can be used in the conquering of space flight, in which information about atomic vapor will be particularly useful. The most advanced heat-resistant materials can also be subjected to ultra-high heating rates for sustained periods.

Versatile Nylon Batting

A NEW type of self-supporting batting made of nylon fibers has characteristics useful for thermal insulation, liquid and gaseous filtration, vibration, and shock absorption, padding, and packing applications.

As a thermal-insulating agent, the material already is being used in the field of guided missiles. As a filtering medium, different degrees of separation can be achieved by using different denier fibers in the fabric or by using blends of deniers. As a vibration absorber $^1/_4$-in-thick pieces of the new material will absorb virtually all of the vibrations induced into a table. As a shock absorber, the material will soften an impact while recovering its normal shape without undue force.

Light weight and permanent resilience make the material a desirable padding and packing agent.

Antifungus, antimildew, rapid drying, and resistant to alkalies and most acids, it will withstand continuous temperatures of 300 F, and can be laminated or stitched by a process utilizing heat-treatment.

Originally developed for use as an interlining in clothing, it has all of the desirable characteristics for such service, many of which are useful in industrial applications. It is nonallergic, light in weight, dimensionally stable under extreme conditions of cold and of heat up to the melting point of nylon itself. It cannot mat, and retains its characteristics through repeated immersions in water. Because of its strength, the material can be used independently of supporting substances in most applications. It can be die cut and can be impregnated with any chemical compatible with nylon.

The material is made by crimping nylon fibers and then permanently locking them together by a patented chemical-thermal process. The fiber crimp gives the fabric added tensile strength and loft as well as imparting permanent resilience. The material is produced in a range of weights from 2 to 8 oz per sq yd, and widths up to 55 in.

Called Ny-Sul-Loft, the material is manufactured by Star Woolen Company, Cohoes, N. Y.

Vibration absorption of nylon-bonded batting is evident in this fist-pounding demonstration. The material is also thermal-insulating, liquid, and gas-filtering.

Computer Application

FORECASTING daily peak loads is important for any electric utility, but particularly so for the Hydro-Electric Power Commission of Ontario, Canada, which must combine hydro and thermal power during periods of low water.

The Commission's chief resource is the Niagara River, whose flow depends on the level of Lake Erie at Buffalo, N. Y. This fluctuates with winds, seasons, and trends in climate. Winds alone have a pronounced short-range effect that may amount to over 500 megawatts of generation.

As part of the Commission's operations research, a system for predicting lake levels was based on a statistical analysis of 65 years of historical records.

Regression equations were developed from the data so that future monthly mean lake levels were determined entirely from the monthly mean lake level for the month immediately preceding the issue of the forecast. The calculation of 288 linear regression equations, 144 for Lake Erie levels, and 144 for Lake Ontario levels, was carried out by Ontario Hydro's Computing Center on an IBM Card Programmed Calculator, replaced since by an IBM 650 electronic computing machine.

Study on peak-demand forecasting also required information on illumination which is the chief factor determining irregularities in week-day peak loads. Thus an essential step in the development of the system was the correlation of illumination with weather variables such as season, precipitation, cloud height, and visibility. To establish a relation between illumination and the other weather variables, illumination records for 1951 to 1953 were compared with punch-card records of hourly weather obtained from the Meteorological Division, Department of Transport, Ottawa.

A classification of weather conditions into 48 categories was made, and the day-time members of the set of 26,000 hourly weather cards were sorted in these categories by the computing center. A random sample was chosen from the cards in each weather category and the corresponding illumination percentages were as-

signed. Tables were then drawn up which show the level of illumination corresponding to each weather category. A method of load forecasting was developed and tested for 10 months. The median error on forecasts made 24 hours in advance has been only 1 per cent.

Low-Velocity Test Gun

SYSTEMATIC testing of lenses against small projectiles of less than 2 mm diam having velocities in the 100 to 700-fps range had to await the development of a Helium Gun by the Biophysics Division of the Chemical Warfare Laboratories. In attempts to fire at low velocities with fixed powder charges, the lowest velocity obtainable varied from 500 to 700 fps, depending on the projectile. When the charge was cut to less than a certain minimum, the velocity dispersion rose to 300 fps and the projectile sometimes stuck in the barrel.

The Helium Gun velocities range from 100 to 1500 fps; the dispersion from a preselected velocity is less than 20 fps; and projectiles as small as a caliber 0.040 sphere, weighing 0.057 grain, can be fired. As the name of the gun suggests, compressed helium gas is the propellant. The gas is supplied from a steel cylinder. A flexible metal hose delivers the gas from a pressure regulator on the cylinder to a small reservoir equipped with an accurate pressure gage. The reservoir feeds into a solenoid valve, into the outlet of which fit the barrels, which range in caliber from 0.30 to 0.042. After the reservoir pressure has been adjusted to the desired value, the gun is fired by activating the solenoid valve through a remote switch. The low-velocity dispersion of the gun is attributed to the precise control of gas pressure and to the fact that the valve remains open more than a second, applying constant pressure to the projectile until it leaves the barrel.

The use of helium is important. Both higher and lower projectile velocities can be obtained than with denser gases, and adjustment from one reservoir pressure to another is made more rapidly. For the laboratory, helium is preferable to powder as a propellant because it is an inert gas, noninflammable, and nonexplosive.

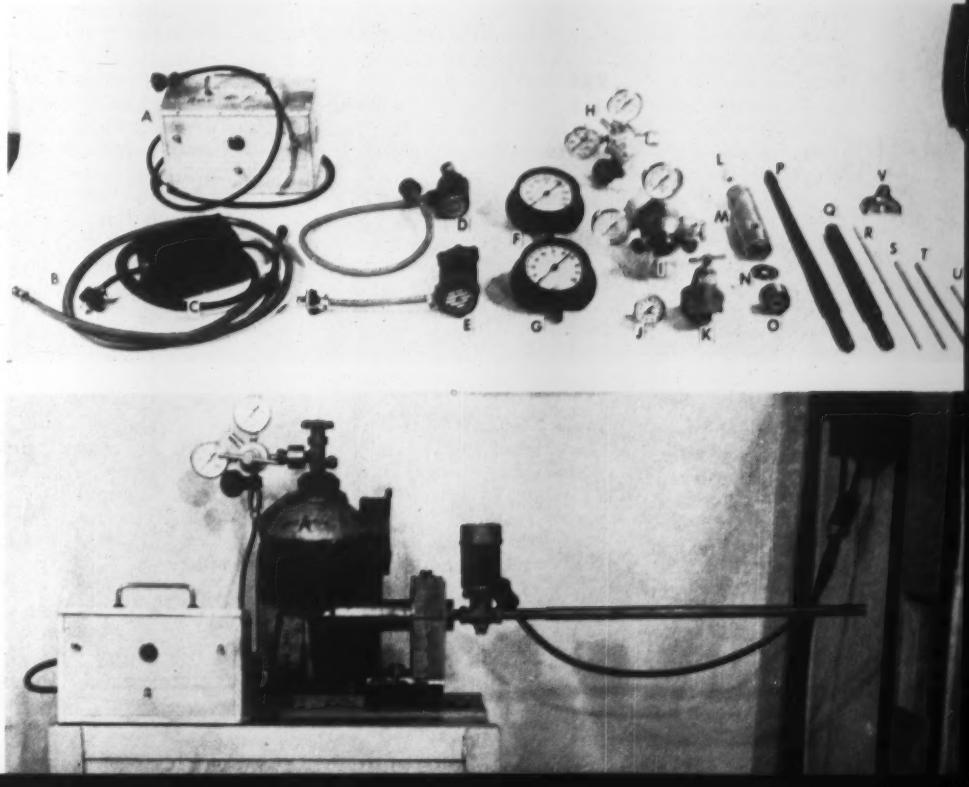
New data on ballistic resistance of lenses have indicated that workers wearing spectacles of untreated optical glass are better protected against flying chips from machines and other industrial projectiles than workers equipped with the heat-treated safety-glass lenses developed in recent years and now worn by millions of industrial workers. This is only the first of the important experimental results expected from the new research tool. The Helium Gun opens a new field in low-velocity ballistic testing of glasses, plastics, cloth, and body armor.

Solids Pipeline

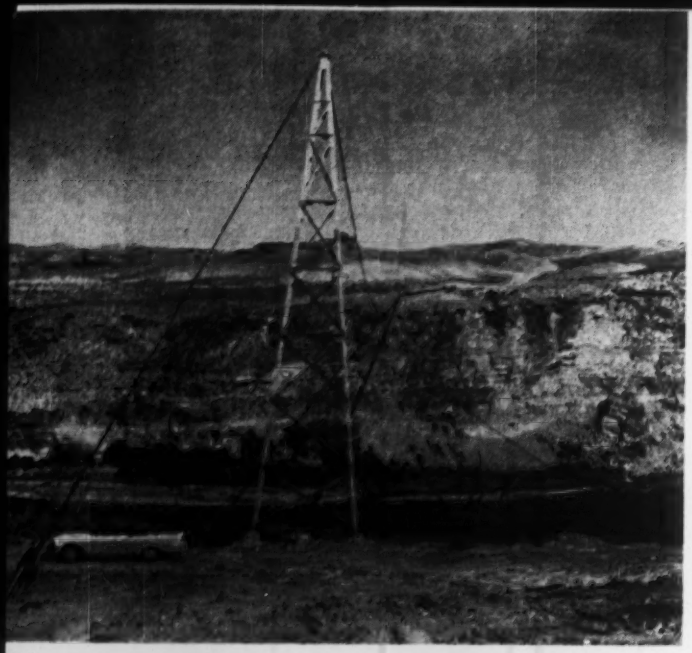
THE FIRST pipeline ever built to transport solid materials over mountainous country has gone into operation.

Running from the mines of the American Gilsonite Company at Bonanza, Utah, the $2-million pipeline extends 72 miles over the towering Book Cliff Mountains to the company's new refinery. Scheduled for completion this spring, at Gilsonite, Colo., near Grand Junction, the 6-in. pipeline will be able to transport 700 tons a day of crushed Gilsonite ore and water. Gilsonite, a trademarked name, is a solid hydrocarbon mined from vertical seams. Coal-like in appearance, it is used to produce high-grade metallurgical coke and gasoline at the new refinery. The gasoline will be marketed in the Rocky Mountains area. The coke will be sold to aluminum producers and other industries for recarburizing and special metallurgical uses.

For virtually all of its length, the pipeline crosses uninhabited country over some of the most rugged terrain in the west. It spans two large canyons via suspension bridges and crosses an 8500-ft mountain pass. The pipeline method of transportation will save several dollars per ton over trucking, the only other available



Components of the low-velocity Helium Gun are: (*a*) firing switch, (*b*) flexible pressure hose, (*c*) relay switch, (*d*) low-pressure solenoid valve, (*e*) high-pressure solenoid valve, (*f*) high-pressure gage, (*g*) low-pressure gage, (*h*) high-pressure regulator, (*i*) high-pressure regulator, (*j*) low-pressure gage, (*k*) low-pressure regulator, (*l*) high-pressure fitting, (*m*) high-pressure chamber, (*n*) gasket, (*o*) high-pressure chamber cap, (*p*) caliber 0.22 rifled barrel, (*q*) caliber 0.30 barrel—smooth bore, (*r*) caliber 0.040 smooth bore—bbl length 15 in., (*s*) caliber 0.125 barrel—smooth bore, (*t*) caliber 0.093 barrel—smooth bore, (*u*) caliber 0.040 smooth bore—bbl length, 6 in., (*v*) blast deflector. Photo, *bottom*, shows the assembled gun which can test spectacle lenses against the impact of small projectiles in the 100 to 700-ft-per-sec range.



Suspension bridges carry a portion of the 72-mile solids pipeline over the White River and Evacuation Wash canyons. It takes 29 hr for a Gilsonite particle to traverse the pipe.

transportation. Adequate water is available at the mines, and hydraulic mining yields ore in prepared slurry form.

Two suspension bridges, one 600 ft long at the White River, the other 700 ft long at Evacuation Wash Canyon, were built to span the deepest points of the line's route. Otherwise, the pipeline is buried $3^1/_2$ ft below the frost line for its entire length. The line follows the route of the abandoned Uintah Railroad.

Pipeline tests were conducted by the Colorado School of Mines Research Foundation at Golden in a 500-ft closed loop of full-sized pipe. Pumping tests were conducted by the Wilson-Snyder Manufacturing Company at Braddock, Pa. Here various pistons, valves, seats, and other equipment, were tested with the Gilsonite slurry.

The 6-month test program indicated that, although the pumps could handle $^1/_4$-in-size particles, results were dramatically improved with an 8-mesh size.

The smaller particle size decreases degradation, or breaking down of the particles in transit, and makes dewatering and maintenance of suspension easier. It was adopted as the design standard.

The entire pipeline is laid at a reasonably flat slope, except for two miles where 21-deg slopes were necessary. Initially, solids concentration of 35 per cent Gilsonite and 65 per cent water will be sent through the line. Uniform slurry will be maintained by two 200,000-gal tanks at Bonanza which will be held under constant agitation.

A unique method of determining pipe-wall erosion losses was devised by California Research Corporation, a subsidiary of Standard Oil of California. A small section of radioactive pipe was placed in the test loop, and careful measurements of the minute amounts of radioactive iron worn away could be made after only a few hours of operation. Gilsonite is very friable and will not abrade steel surfaces. It is completely insoluble in water and naturally free of impurities. A chemical-corrosion inhibitor will be used since the solids apparently scour away any natural protective coatings that are formed on the pipe wall.

The pipeline is designed for continuous flow, and will be shut down only after all the slurry is flushed from the system. Three electric-driven slurry pumps are at the Bonanza pump station, two are normally used, and one is a spare. If the power should fail, a diesel-driven pump will be cut into the line and flush the system with water. This pump usually provides high-pressure water for ore cutting in the mines. A final measure of protection is the 8500-ft-high reservoir at the summit of Baxter Pass, which can flush the system in both directions. A high-pressure pump at the refinery can backflush the line.

These precautionary measures are all easy to provide and mean extra insurance against plugging of the line. The pilot tests showed that so long as adequate velocities were maintained, slurry could be continuously circulated without build-up of solids. The 300-hp reciprocating pumps operate at 325 gpm, and discharge pressure is 2370 psi.

The pipeline was designed by the Engineering Department of Standard Oil Company of California. The de-watering operation at the Gilsonite, Colo., end was worked out by Standard's engineering department with Allen & Garcia of Chicago, Ill., and engineers of American Gilsonite Company.

Mathematics of Oil Flooding

Much of the expensive guesswork of oil exploration may be eliminated by mathematics.

The Research Division at New York University's College of Engineering is working on a project, sponsored by the Arabian American Oil Company (Aramco), to draw a basic mathematical model of "the hydrodynamics of two-phase flow in porous media," useful in the system of forcing oil to the surface by pumping water or gas underground known as "flooding." The technique is used increasingly where the natural pressure of crude-oil pockets has fallen off after being worked for from five to ten years.

Sinking water or gas wells for "flooding" costs from $300,000 to $400,000 for a 7000-ft well, and oil companies want a scientific basis for sinking the flooding wells and the pressures to be used.

Random spotting of flooding wells rarely brings up as much as 40 or 50 per cent of the residual oil known to be underground.

Mathematical knowledge of the rate at which individual particles of oil and water separate is essential to a scientific system of flooding. One reason the present system brings a low percentage of oil to the surface is that a good amount of water is brought up too.

The water that does the immediate "pushing" is already in the pores of the rock layers; in fact, it originally trapped the oil in its pockets. In the flooding method, the underground water is itself pushed by gas or water pumped down from the surface.

The complexity of the mathematics is such that the problems could not be handled without high-speed electronic computers, according to Emanuel Mehr, associate engineering mathematician and director of the project. "A few years ago," he stated, "they would have been hopeless."

The researchers will use the group's IBM 650, a medium-sized computer that can "memorize" 20,000 digits in its magnetic drum.

Conductive Silicone Rubber

THE commercial availability of a silicone rubber compound with a high degree of electrical conductivity has been announced by the Silicones Division, Union Carbide and Carbon Corporation, New York, N. Y. The material "Union Carbide" X-1516, a silicone rubber compounded with conductive carbon blacks, is said to provide the highest degree of electrical conductivity now commercially available in a flexible, thermosetting material. With X-1516, electrical resistivities of less than 100 ohm-cm are easily obtained.

The electrical properties of the product are not appreciably changed by mechanical working during processing and are therefore uniform throughout any fabricated product; it can, therefore, be molded, calendered, or extruded without its electrical properties being altered appreciably.

Superior conformance to extrusion die contours and mold surfaces allows the material to be made into difficult or odd shapes. It could, possibly, be used to make an electric heater which would not break as easily as ceramic or graphite heaters.

Like other types of silicone rubber, X-1516 has thermal stability; inertness; resistance to weathering, corona and ozone; and adhesiveness, or the quality of not sticking. Industrial rolls in machines of various types fabricated from X-1516 combine electrical conductivity with these qualities. The fact that such a roll is electrically conductive provides means for dissipating static electricity, or heating the surface of the roll, or both.

Since X-1516 can be extruded in the form of an electrically conductive tubing or hose, it may be found effective to drain static charges and prevent sparking in hospital operating rooms, or in handling explosive gases or dusts.

Because of its conductivity and its resistance to temperatures as high as 400 F, the material can be used to make antifogging heater pads on aircraft cameras.

The material is also suggested for uses where: (*a*) An electrically conductive rubber is required to operate at higher or lower temperatures than are possible with other rubbers; (*b*) high stability of electrical conductivity during processing is required; (*c*) uniformity of electrical conductivity throughout a product is desired; (*d*) a series of compounds with various electrical conductivities is needed; (*e*) difficult problems in fine profile extrusion are encountered and electrical conductivity is either required or is unimportant; and (*f*) the adhesive properties of silicones are needed in conjunction with electrical conductivity.

Contact Printer

TEMPLATES up to 30 ft in length can now be reproduced with a new contact printer doing production work at the Columbus, Ohio, Division of North American Aviation, Inc.

The printer is the result of a North American Aviation idea which was brought to design completion by Miller-Trojan Manufacturing Company of Troy, Ohio. It was developed to meet a need for a printing surface of sufficient size and versatility to handle all the tooling reproduction requirements of an aircraft manufacturer.

Designated the Model 360-72 (usable printing surface is 360 × 72 in.) the machine consists of two printing units mounted end-to-end. Each unit can be operated separately or simultaneously from either of two control panels.

In operation, the layout to be duplicated is placed on the cast glass printing surface. The sensitized material is placed over the transparent master layout and the top closed. Vacuum holds layout and material to be printed in close contact during exposure. Exposure time is controlled by automatic timers. Various materials such as metal, masonite, paper, etc., can be sensitized and exposed.

Light source for the exposure is a bank of rapid-start fluorescent lamps manufactured by General Electric.

A unique feature is the raising and lowering of the lids with powered Saginaw ball-bearing screws. The lids remain parallel to the printing table at all times. This method replaces the old "clam shell" or "removable blanket" type used on other printers.

Greater flexibility and capacity are achieved with this "twin-unit" machine because normal work can be fed to either unit independent of the other. When large prints are required, the operator throws a special switch and the two units operate as one. An average cycling time of the machine is approximately three minutes. Because of its simplicity, semiskilled workers can be easily trained to operate the printer.

Layouts 30 ft long can be accommodated on this contact printer, *left*, doing production work at the Columbus Division of North American Aviation, Inc. It is used to reproduce templates. Flexibility of the contact printer is demonstrated, *in center* photo. Tops can be operated independently of each other, or as a single unit. A unique feature, *right*, of the contact printer is the method for raising and lowering the lids. Saginaw ball-bearing screws do the job.

Coal-Burning Gas Turbine

A NEW fuel system in which $^{3}/_{16}$ in. × 0 dried coal flows from aerated tanks without need for mechanical conveyers has been installed on the coal-burning gas turbine, which Bituminous Coal Research, Inc., of Pittsburgh, Pa., has been developing for locomotive use for some years at Dunkirk, N. Y.

Finely crushed specification coal is handled as a fluid in this completely automatic system, with a pulverizer built by the Riley Stoker Company from designs prepared in co-operation with the Locomotive Development Committee Staff of BCR. A rotary pump delivers crushed coal into the conveying air which carries the coal through a pressurized-unit pulverizer to the turbine combustors.

The rotor blades of the turbine have been modified to reduce dust damage, and skimmers installed on the curved surfaces of the turbine-inlet configuration, in order to draw off fine ash particle concentrations. Although no definite evaluation can be made until after 1000 hr of testing are completed, there have been no signs of wear, erosion, or other distress on the blades after the first 325 hr of operation.

In addition to potential competition with diesel locomotion, the coal-burning gas turbine should have extensive application for power generation in the 3036 nonutility power-generating plants in the United States which are principally municipally and industrially owned. About 35 million tons of coal for railroad use and up to 110 million tons for power generation could be recaptured if the total potential market were developed.

Of the 3036 privately owned power generating plants, 1454 are 1000 kw capacity or smaller, and 587 are between 1000 and 3000 kw. In other words, more than one half the total privately owned power generating plants are equivalent in size, or smaller than, the coal-burning gas turbine developed by the Locomotive Development Program for railroad motive power. The 279 plants between 3000 and 6000 kw could be handled by two such units, although single units in this size range are under development. The 160 more plants in the range of 7000 to 9000 kw could be handled by installations of three such units in each plant, and 123 plants could be handled by four such units.

Four industries have very good possibility for extensive application of the coal-fired gas turbine for generating power. All four would probably have use also for the hot exhaust gases obtainable from the gas turbine.

The four industries are: Municipally owned plants, paper and allied products plants, chemical and allied products plants, and plants owned by the primary metals industry.

Blast-Furnace Gas-Turbine Blower

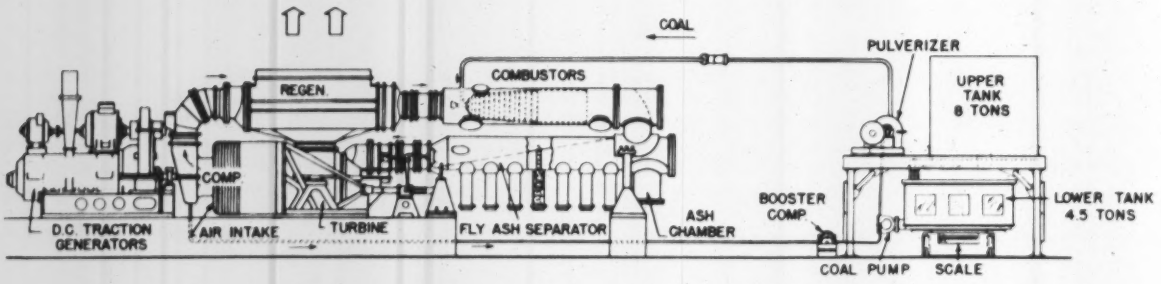
WESTINGHOUSE Electric Corporation's steam division at Lester, Pa., will build a gas-turbine blowing system capable of supplying 125,000 cfm of air to blast furnaces at United States Steel Corporation's South Works at Chicago, Ill.

The new system scheduled for delivery in 1958 will be the first application of a gas turbine for furnace blowing in the American steel industry.

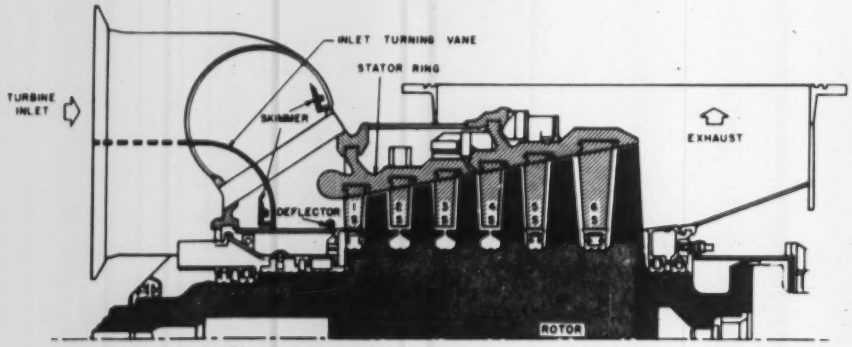
More than five years of research went into the project to determine advantages of the new system in comparison with conventional systems now in use.

Research data show that not only the initial cost, but operating and maintenance expenses of the gas-turbine system, should be lower. The gas-turbine system requires less space and uses practically no water.

Steel-mill blast furnaces currently use systems in which combustible gas from the furnace is drawn off and used



▲ The coal-burning gas turbine of Bituminous Coal Research's Locomotive Development Committee utilizes finely crushed coal delivered into the conveying air by rotary pump, and carried through a pressurized-unit pulverizer to the turbine combustors



◀ Changes made during 1956 in the turbine-inlet configuration and blade arrangement are described and shown in this diagram

NEW ROTOR BLADES AT LOCATIONS R1, R2, R3 AND R4. ORIGINAL BLADES AT LOCATIONS R5 AND R6.

INNER STAGE SHROUD AND SEAL RINGS REMOVED AT LOCATIONS S2, S3 AND S4. NO NEW STATOR BLADES ADDED.

DEFLECTOR RING INSTALLED IN FRONT OF FIRST ROW STATOR BLADES TO AVOID CONCENTRATION OF DUST AT INNER ROOT.

SKIMMERS INSTALLED ON THE CONCAVE FACES OF BOTH TURBINE INLETS TO COLLECT AND BLOWDOWN NATURAL DUST CONCENTRATION.

to fire steam boilers. The steam drives a turbine which powers a centrifugal compressor supplying air to the furnace.

The new Westinghouse system eliminates the need for a boiler and its auxiliary equipment. The blast-furnace gas is used to power the turbine which drives an axial-flow compressor capable of supplying air to the furnaces at 35 psi. It also supplies combustion air for the turbine at the same pressure, while a fuel compressor compresses the gas.

Metal Bellows

Flexible expansible and collapsible metal bellows have numerous uses. Many millions of them control temperatures of internal combustion liquids, and innumerable refrigerator compressor shafts have been sealed with them. They are used to control draft dampers on domestic heating equipment, refrigeration switches, and pressure switches, to adjust fuel mixtures on aircraft engines, for regulator valves on steam systems, and in many instrument applications.

According to an article on their design, manufacture, and application by G. E. McKinney, applications engineer, Fulton Sylphon Division, Robertshaw-Fulton Controls Company, Knoxville, Tenn., there are several processes which will produce a convoluted vessel; those manufactured by the company are formed from a tube. The formation is one of the more difficult steps in bellows manufacture, since final wall thickness is rarely more than 0.004 in. to 0.010 in. Extremely careful control of tube dimensions is mandatory, since the characteristics of the finished bellows depend in a very large degree on the condition of the metal, the final dimensions, and uniformity of the walls in the bellows tube.

The simplest method of forming the tube is to bend a flat sheet of thin material around a suitable mandrel and join the ends by welding or brazing. This permits making tubes in a wide variety of diameters and lengths, with a minimum of expensive tooling. However, the presence of the seam down one side obviously affects the characteristics of the bellows. One side will be stiffer than the other, and the chance for leaks is much greater than with a seamless tube.

The process for drawing a seamless tube employs blanking, cupping, annealing, drawing, redrawing, and trimming operations in a variety of combinations. The sheet stock from which the blank is made is usually either 0.0225 in. thick or 0.051 in. thick, compared to a final thickness of 0.004 in. in some bellows tubes.

The corrugations on the tube are formed in one of two ways. In the rolling process the tube is subjected to a series of rolling operations which gradually narrow and deepen the relatively broad, outwardly formed corrugations produced by the initial expanding operation. This procedure, used for most bellows above approximately 4 in. OD, imparts considerable cold working to both inner and outer bends. Bellows up to about 48 in. OD have been successfully formed on an experimental basis by this process. It is often used on smaller bellows when heavy-walled, multi-ply construction is required and suitable hydraulic forming equipment is not available.

In the hydraulic process the bellows is formed by a combination of hydraulic pressure applied internally to the tube and mechanical force applied endwise to the tube. A partable collapsible die of plates, machined to the proper shape, and spaced the correct distance apart, is employed to outwardly form the corrugations. Four steps follow in rapid succession after the tube is confined in this die:

1 The open end of the tube is connected to a source of hydraulic pressure at from 200 psi to, sometimes, several thousand psi depending on the diameter and thickness of the tube.

2 Hydraulic pressure is admitted to the inside of the tube.

3 The side walls of the tube are bulged between the individual plates.

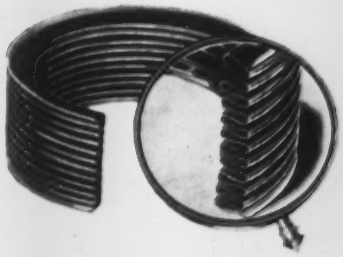
4 Endwise force applied to the tube collapses the die and folds the corrugations out to their ultimate diameter. Hydraulic pressure maintained inside the tube during this folding operation prevents it from wrinkling.

The bellows is removed from the parted die, tested for leaks, the surplus tube trimmed from the open end, and is "set" down to its natural free length.

This hydraulic process is well adapted to high production and produces excellent bellows.

Upon being set to length, the bellows assumes characteristics which are in some respects similar to a helical compression spring. A bellows has a "spring rate," affected by many factors, which is an important consideration from the designers's viewpoint. Some of these are: Material, wall thickness, number of free plates, ratio of OD to ID, number of plies, and so forth. As the rate varies with these factors, the bellows' response to load changes is directly affected.

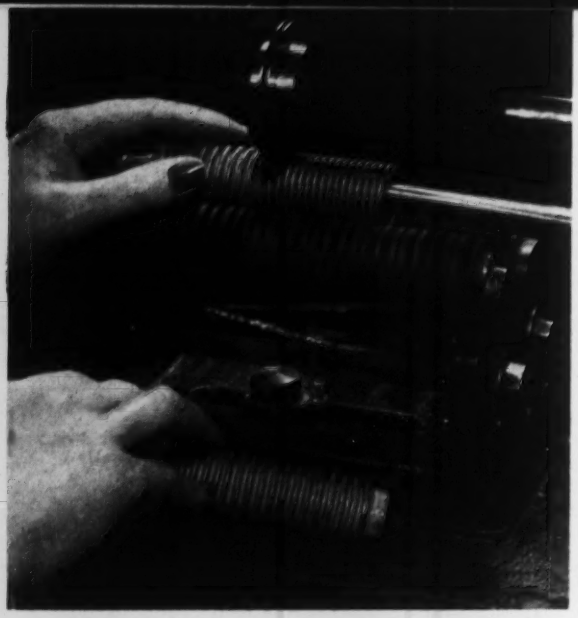
A bellows has an "effective area," which is a value less than the area of the OD but greater than the area of the ID. The bellows then responds to changes in pressure, internally or externally applied, acting on the area, and producing axial movement as permitted by the spring rate.



Metal bellows are actually flexible expansible and collapsible metal vessels consisting of a series of annular plates having their inner and outer surfaces joined together by curved surfaces

The spring rate is a function of the cube of the wall thickness, and the pressure resistance of a bellows is a function of the square of the wall thickness. Thus it can be seen that increasing the wall to get increased pressure resistance will produce an even greater increase in spring rate. This situation can be improved by using multi-ply construction, which makes possible the required increase in pressure resistance with less increase in spring rate than with a thicker single ply. At the same time, bending stresses are maintained at the same level, since each ply carries its proportionate share of the load. An increase in bending stress is an unavoidable by-product of heavier single-ply construction.

As we have seen, the characteristics of bellows are affected by the material from which they are formed. By far, the greater production of bellows is of 80/20



In the rolling process of metal bellows manufacture, a tube is subjected to a series of rolling operations which gradually narrow and deepen the relatively broad, outwardly formed corrugations produced by the initial expanding operation

brass materials. To meet certain conditions of corrosion, as well as to obtain the advantages of different material characteristics, bellows are manufactured at the Fulton Sylphon Division from phosphor bronze, monel, stainless steel, inconel, and in ever-increasing quantities, from beryllium copper. Experimental work is continuously in progress to find new materials and new processes to keep up with industries' rapidly-increasing demands for more, better, and less-expensive bellows.

"Lexan" Thermoplastic

A NEW plastic material tough enough to replace cast metals, ceramics, and other plastics in many applications has been discovered by the General Electric Company.

"Nail"-like rods molded from General Electric's Lexan plastic can actually be driven into a piece of lumber with a carpenter's hammer

Properties of G-E Lexan Molding Compound

Property	Values[a]	ASTM No.
Impact strength, notched Izod, ft-lb per in.	12–16	D256
unnotched Izod, ft-lb per in.	50	D256
Tensile impact, ft-lb per cu in.	600–900	
Tensile yield strength, psi	8000–9000	D638
Tensile ultimate strength, psi	9000–10,500	D638
Elongation, per cent	60–100	D638
Flexural strength, psi	11–13,000	D790
Water absorption, 24-hr immersion, per cent	0.3	D570
Indentation hardness, Rockwell	M70	D785
Specific gravity	1.20	D792
Air resistance, sec	100–140	D495
Dielectric strength, short time, 1/8-in. thickness; volts per mil	400	D149
Dielectric constant, 60 cycles	2.80	D150
10^6 cycles	2.85	D150
Power factor, 60 cycles	0.009	D150
10^6 cycles	0.0095	D150
Volume resistivity, ohm-cm	6×10^{15}	
Heat distortion temperature, 264 psi	280–290 F	D648
66 psi	283–293 F	D648
Mold shrinkage, in-per-in.	0.005–0.007	D955
Thermal conductivity, cal/sec/cm²/°C/cm	4.6×10^{-4}	
Coefficient of linear thermal expansion, in./in./°C	7×10^{-5}	D696
Melting point (crystalline)	514 F	
Flammability	self extinguishing	D635

[a] Unless indicated otherwise, these values were determined at room temperature on injection-molded samples. Ultimate properties of this new polymer may vary from the values listed above. Lexan molding compound is not presently available for field evaluation.

Lexan resin offers an unusual combination of toughness, impact strength, heat resistance, and dimensional stability. These properties make it promising for applications not previously handled by conventional thermoplastic materials.

Initial discovery of the polycarbonate polymers which led to the Lexan development was made at the General Electric Research Laboratory in Schenectady, N. Y. Further development of the material has taken place in the laboratories of the Company's Chemical Development Department at Pittsfield, Mass.

Lexan resin is not being made in small lots at the applied research laboratory at Pittsfield, and all available material is going into the Company's testing program. The polymer is being evaluated in the form of molding compound, extrusion compound, film, varnish, and coatings.

Until the present evaluations have been completed and pilot-plant production established, samples will not be available for general distribution.

Early studies indicate that Lexan resin can be made in a variety of transparent or opaque colors, with parts showing good surface hardness and gloss. Properties of the polymer suggest its use in such applications as coil forms, decorative and functional appliance parts, gears, automotive parts, housings, structural parts, handles, drawer rollers, electronic components, and telephone accessories.

The excellent electrical characteristics, high thermal stability, low water absorption, and high tensile strength of Lexan film make it suitable for use as an electrical insulating material.

Instrument Readability Improved

SURPASSING ASA readability standards by 200 per cent, and 20 per cent better than those manufactured at present, are a series of switchboard instruments for easy reading at better than 120-deg angles.

The improved instruments, engineered by General Electric, include voltmeters, ammeters, wattmeters, frequency meters, power-factor meters, varmeters, synchroscopes, temperature meters, and ground detectors.

Standard ASA specification for angles of readability in switchboard design is ±20 deg. The new design shows tested legibility and easy reading at ±60 to 65 deg.

The new instruments are particularly useful for utility and mill installations where distant angular readings must be taken and maximum legibility is essential. They can also be used for general switchboard service, control panels, and special test equipment.

Cover overhang—major cause of scale shadows—has been eliminated, making it possible to read markings clearly regardless of the angle of illumination. The instrument scale has been moved forward to a position flush with the front of the cover bezel, and a protruding glass cover provides clearance for scale and pointer.

To eliminate parallax errors, the instrument scale is so constructed that the tapered-pointer tip is in the same plane as the scale markings. Numbered divisions, accented for quick correlation between numerals and markings, are horizontally mounted and the legend cannot be obscured by the pointer.

The convex-type, antistatic, lime-glass cover presents a minimum of flat surface and greatly reduces glare from angle lighting. For applications where unusual lighting problems lessen angles of readability, the instrument can be made with a special antiglare glass, acid-etched to reduce glare.

Comparison shows improved angle of readability of General Electric's newly designed switchboard instrument and distortion of previous model when viewed from ± 60-deg angles or better

The Reasons for Establishing Euratom

(Continued from page 559)

prove and improve these designs and to define and progressively reduce their costs in actual operating conditions. Therefore a partnership with the United States would provide Europe with the necessary prerequisites for success and could provide you with invaluable experience through the large-scale industrial application of atomic power.

We should be able to start, with a minimum of delay for redesign or testing, by ordering plants more or less identical with those full-scale units already in the course of construction in the United States and the United Kingdom. Perhaps we will have the first million nuclear kilowatts in service by 1961. Long before these first units come into service, we will want to develop further refinements in reactor designs to suit Europe's particular needs as well as to exploit all general improvements to date. Our requirements are, in many respects, unique. For one thing, we will not have a military counterpart program to shoulder the main burden of technical development and to provide U-235 and absorb Pu-239. Our big-scale peaceful program will also pose the problem of what reactor types we must develop, to what extent we should concentrate our early efforts upon a natural uranium system with a high burn-up, and upon the enriched throw-away approach, therefore postponing the problem of reprocessing fuels on a large scale.

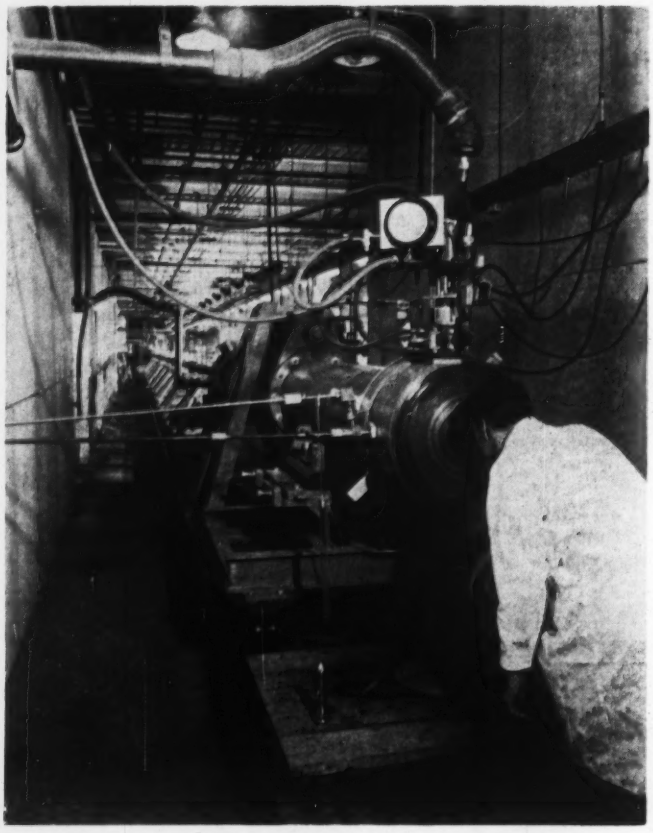
Alternatively, to what extent should we bank upon the economic feasibility of plutonium recycling, and on a thorium fuel cycle in the type of reactors we will build in the first years? Further, to what extent should we plan our program so that it yields a surplus of fissionable material, that is to say, U-235 and Pu-239, in the later 1960's, to be in a position to provide fuel to start off the homogeneous breeder reactors we expect to be ready for commercial use by that time? We hope to work out many of these difficult problems in very close collaboration with our American friends.

A new relationship between the United States and Europe seems to be within our reach. An association between the United States and Europe for the development of the peaceful uses of atomic energy will help us in many ways: It will help solve our power supply problems and will thereby contribute to a healthy and normal political relationship between the Middle East and Europe. Together with the efforts your Government is making in this area, this step will be of great importance for safeguarding peace in one of the most troubled areas of the world. At the same time, our association would provide you with the immensely practical experience of having your technical accomplishments tested through full-scale commercial application. Lastly, it would go far toward making a great contribution in the field of nuclear power and lend new hope to those countries in the world who, in relation to our nations, are regarded as economically underdeveloped.

Again Europe needs your help, but this time we will build a two-way street. Our relationship will not be that of one country giving and another receiving, but of two great united nations, the United States of America and the United States of Europe, working in association with each other to the mutual benefit of themselves and the world.

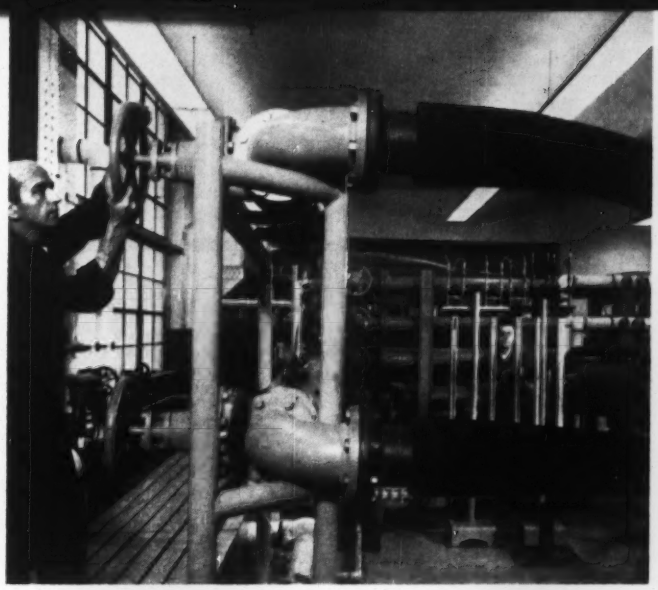
Reactor Fuel Loading
Atomic fuel in the form of uranium slugs contained in stainless-steel jackets is lowered into the core of the Sodium Reactor Experiment. The experimental nuclear power reactor is being built by Atomics International, a division of North American Aviation, Inc., as part of the AEC program to develop economical power from atomic energy.

Photo Briefs

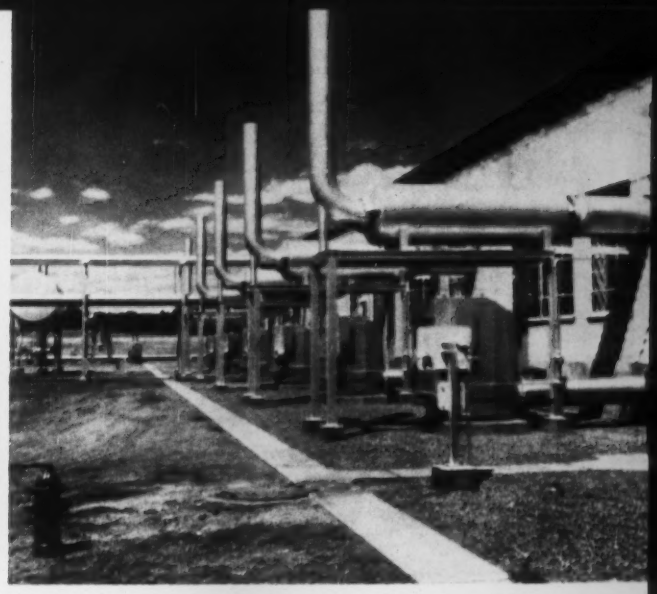


Shock Tube
This cannonlike device is Avco Manufacturing Corporation's 100-ft-long shock tube, largest of a series of hypersonic shock tubes at the company's Everett, Mass., Research Laboratories. Avco developed the hypersonic-shock-tube series for studies in high-speed high-altitude flight, including problems of bringing the Air Force intercontinental ballistic missile back into the earth's atmosphere from outer space in spite of extreme frictional heat. Avco will offer custom-made shock tubes to industries, universities, and specialized research teams.

Feed Screws
These 508-lb 9-in-diam 54-in-long feed screws are made of special stainless steel called Pandaloy. The Black-Clawson Company will use them in pulp-making equipment. They are being tested for hardness by Allegheny Ludlum Steel Corporation.

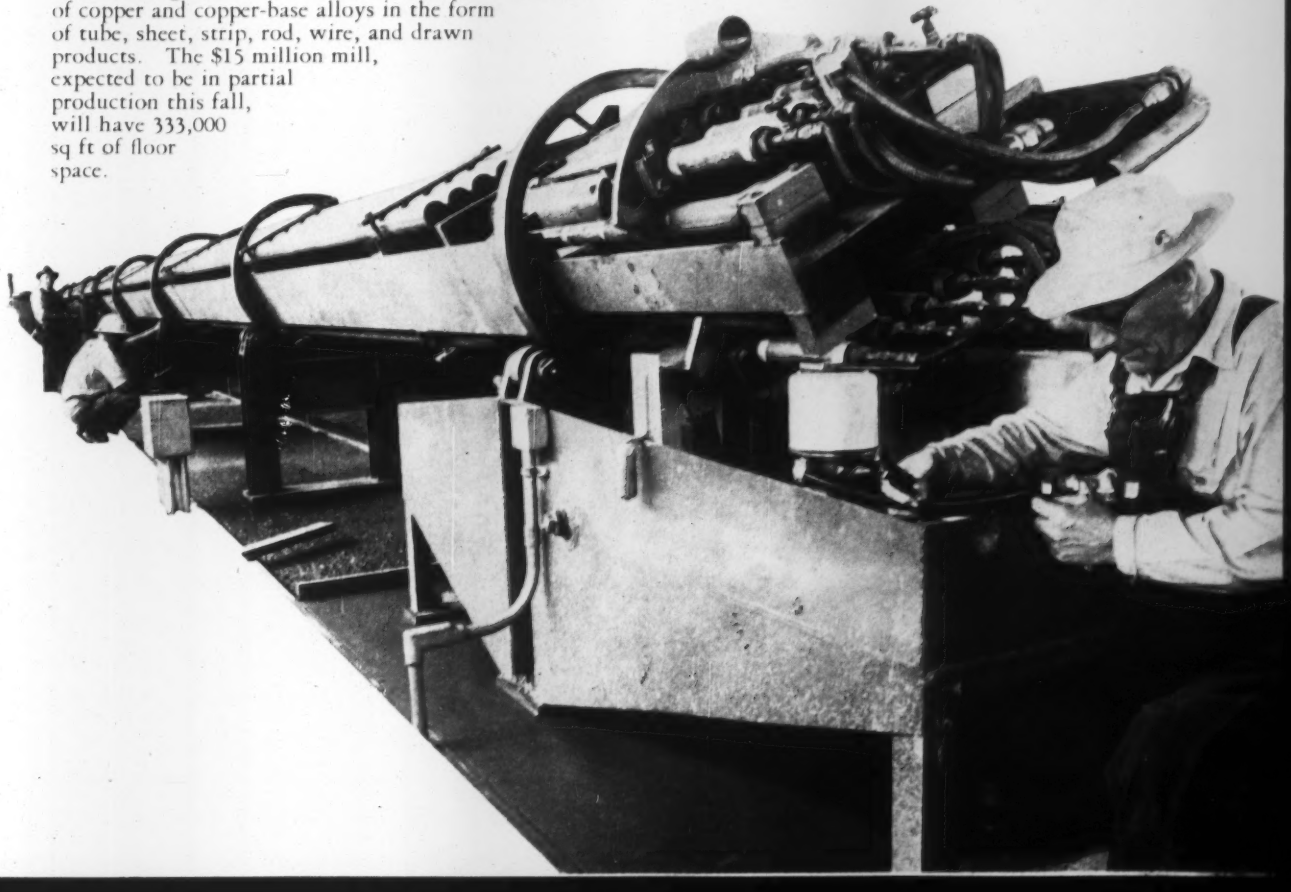


Heat-Transfer Fluid-Flow Laboratory. Alco Products, Inc., will test full-size units up to 36 in. in diam in the new laboratory at Schenectady, N. Y., rather than the working models used at other research centers. . Eight temperature readings can be taken in slightly less than 1 min. Approximately 1000 test runs will be made covering oil, water, and steam flow on the Alco Twin-Fin® heat exchanger now undergoing tests.



Exhaust Snubbers. Straight-through low-pressure-drop exhaust snubbers made by Burgess-Manning Company are installed on six Clark model TLA turbosupercharged-type gas-engine compressors at the Durango, Colo., station of the Pacific Northwest Pipe Line. The snubbers were developed exclusively for use in silencing the piercing exhaust noise of engines at the 13 stations of the line which extends from New Mexico to Washington.

Draw Bench. A 36,000-lb quintuple-die copper-tube draw bench at the Paramount, Calif., plant of the American Brass Company will produce 5 tubes at a time, each 125 ft long. Annual capacity of the company's new Los Angeles Division is estimated at 30 million lb of copper and copper-base alloys in the form of tube, sheet, strip, rod, wire, and drawn products. The $15 million mill, expected to be in partial production this fall, will have 333,000 sq ft of floor space.



European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

Glockner-Kaprun Power Scheme

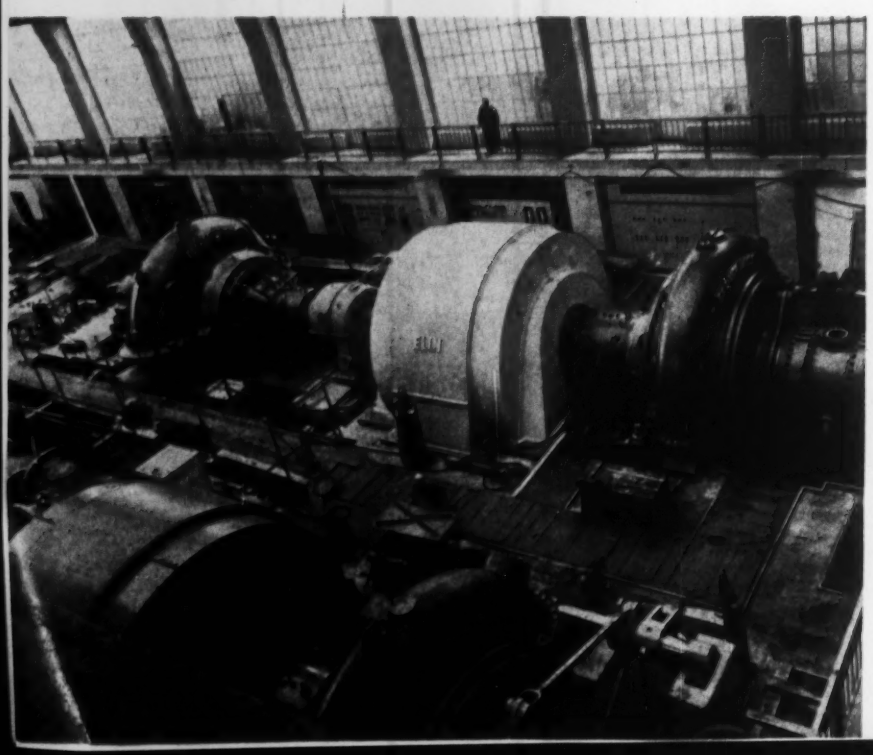
One of the most important hydroelectric power projects in Europe, the Glockner-Kaprun scheme in Austria, is nearing completion. It is situated in the valley of the Kapruner Ache, a tributary of the Salzach River, some 37 miles from Innsbruck and not far from Zell-am-Zee, and is of particular interest technically because of the use that is made of pumped storage. Two of the centrifugal pumps installed for this purpose are claimed to be the largest in Europe and possibly in the world. There are three reservoirs, Margaritze, Mooserboden, and Wasserfallboden, of which the last is the principal, and the whole system extends over a distance of about 27 miles. The water in the Wasserfallboden is maintained at a level of 1672 meters above sea level by the Limberg Dam, a massive structure of the arch type, 120 meters high, 370 meters along the crest, and containing 433,000 cu meters of concrete. At the foot of this dam is a powerhouse with two turbines driving generators which can be used also as motors to drive the two high-lift storage pumps. The water from the Wasserfallboden also flows directly to the powerhouse at Kaprun, at the lower end of the valley, in which are four generating sets, each driven by two single-nozzle Pelton wheels and running at 500 rpm. Two of these sets are of 45,000-kw capacity and two of 55,000 kw.

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

The Kaprun station is of normal design and presents no exceptional features, though the units are of considerable size. The Pelton wheels were constructed by Escher Wyss A.G., of Zurich, and the three-phase generators by the Elin works in Austria.

The unusual part of the scheme is the plant in the Limberg powerhouse. The two combined generating-pumping units are arranged side by side. Each consists of an 84,000-hp horizontal-spindle Francis turbine directly coupled to an Elin generator with an output of 62,500 kw and, in line with it, a storage pump. The pump is connected to the generator shaft by a claw coupling. On the generator side of the coupling is a small impulse turbine for braking purposes, to shorten the time required to change over from generating to pumping, and vice versa. The coupling is operated by a servomotor at the opposite end of the pump shaft, acting through the bore of the shaft. The outlet from the turbine runner has a bore of 1422 mm and the consumption of water is 18.75 cu meters/sec, at a head of 364 meters. The unit runs at 500 rpm.

The turbine runners are of nickel-chrome cast steel. The pump is driven by the generator, acting as a motor, when pumping is required, and the turbine then rotates in air, the rubbing parts being cooled by a water service. A thrust bearing is provided, capable of taking a load of 116 tons in either direction. The turbine and the pump have separate lubricating systems. The pumps are double two-stage units, having three impellers, a double-entry impeller being mounted in the center of



Limberg powerhouse in Glockner-Kaprun hydroelectric power scheme. Background, *left to right*, pump, generator, motor, and turbine. In foreground is second set under construction.

the shaft with a single-entry impeller on each side of it. The casing is of cast steel. The shaft, about 27 meters long, has a maximum diam of 820 mm in the center, reduced to 600 mm in the bearings, the centers of which are 7.45 meters apart. The two inlet branches are 1350-mm bore.

The pumps deliver water to the intermediate Mooserboden reservoir during periods of slack demand for electricity, the level of this reservoir being 355 meters above that of the Wasserfallboden reservoir. The Margaritze reservoir is about $11^1/_2$ km farther back among the mountains than the Mooserboden reservoir, but is at a lower level, so that water must be pumped up about 35 meters to Mooserboden. The Margaritze reservoir serves to collect the flow from a number of small rivers, and others flow into the system at various points; it is a small reservoir compared with the other two, having a capacity of only one million cu meters, whereas Mooserboden and Wasserfallboden each contain 84 million cu meters. The tunnel from Margaritze to Mooserboden has a bore of 2.6 meters; those from Mooserboden to Wasserfallboden and from Wasserfallboden to the Kaprun station are 3.2 meters bore. The complete scheme is expected to provide an annual output of 600 million kwhr.

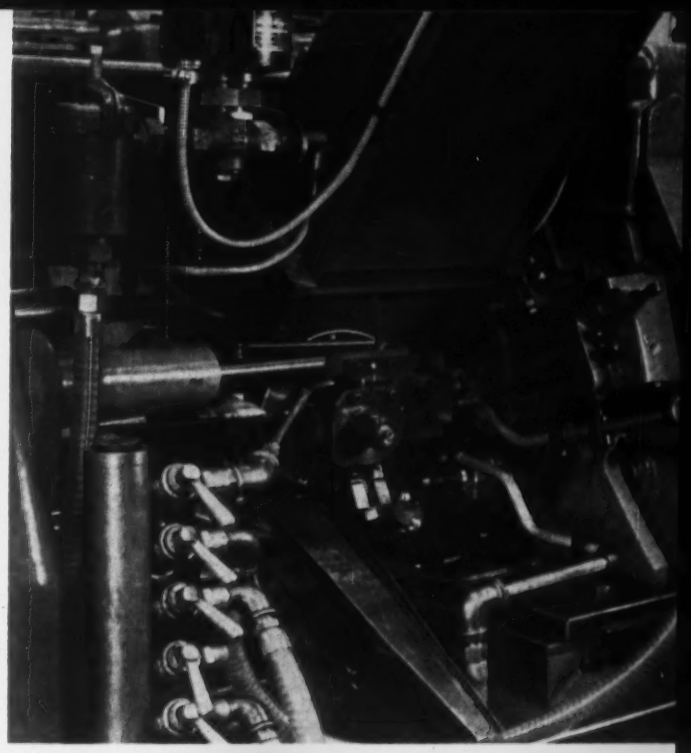
More About Finlarig

FURTHER details have recently appeared about the 30,000-kw double Pelton wheel generator (see April, 1957, issue of MECHANICAL ENGINEERING, p. 372) at the Finlarig power station, Scotland. The alternator has a maximum continuous rating of 35,194 kva, 11,000 v, 3-phase, 50 cycles, 0.85 lagging power factor, and is designed for a runaway speed of 705 rpm. The stator frame is fabricated in two parts, split on the horizontal diameter. Dovetail key bars inside the frame support the stator core, of segmental steel laminations; it is clamped between steel segmental flanges. The rotor is built up of thick steel plates, shrunk and keyed on the shaft, which is nearly 30 ft long. Dovetail slots machined in the rotor body carry the poles, and taper keys are driven in from both ends to hold them hard down on the body. The field coils are fabricated from copper strip, with micanite as the main insulation and the interturn insulation of asbestos. The complete stator weighs 58 tons, and the rotor 127 tons. To reduce the over-all length of the set, the main exciter is placed between the stator and the main bearing at the end opposite to the slip rings, the armature being carried on the main shaft. The pilot exciter and governor generator are mounted on a common baseplate and flexibly coupled to one of the Pelton turbines.

Hardening During Machining Cycle

THE B.S.A. Tools Group, Kitts Green, Birmingham, England, who manufacture Acme-Gridley multispindle automatics, have recently supplied to Vauxhall Motors, Ltd., a 1-in. six-spindle machine fitted with an attachment for the local hardening of the component by induction heating and quenching during the machine cycle.

The machine is producing a rocker-adjusting screw for automobile engines, and the tooling setup also includes burnishing, thread-rolling, and rear-end slotting; thus the component can be machined and completely finished in the one tooling setup. It is made from accurately sized bar so that no machining before thread-rolling is required.



The shrouded coil assembly and concentrator quenching fluid filter, *left*, and time switch valve, *right*, for controlling flow. 5th position pickup attachment is advancing to accept component about to be picked off.

The sequence of operations is as follows: Position 6, feed stock, turn stem, and rough-radius. Position 1, form thread-roll approach angle (60 deg) and finish-face radius end. Position 2, form and break down rear end, steady and burnish radius end. Position 3, form identification groove and thread-roll (the cams are timed to carry out these operations consecutively, to avoid interference). Position 4, induction hardening. Position 5, part off, pick up in the indexing pickup attachment, and slot rear end.

The high-frequency equipment for induction hardening is a standard 7.5-kw Wild-Barfield generator, supplied by Wild-Barfield Electric Furnaces, Ltd., Watford, Hertfordshire, England. It is placed near Position 4, with the high-frequency leads carried through a screened duct attached to the top of the machine frame. The concentrator is carried by the same frame bracket, and is designed so that no oil can splash on the component during hardening. The cutting oil used by the machine is also used for quenching and to cool the primary of the concentrator. The quench valve is operated by a solenoid. A magnetic filter is inserted in the pipe before the quench valve to prevent the passage of fragments of swarf, which might foul the concentrator. The component is $1^{13}/_{32}$ in. long and $^7/_{16}$ in. in diam, screwed 20 threads per inch. The production rate is 514 per hr. The spindle speed is 1161 rpm and the cutting speed 122 fpm.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Gas Turbine Power

Determination of Turbine-Stage Performance for an Automotive Power Plant, by L. B. Mann, Jr., A. H. Bell, and G. W. Thebert, Chrysler Corporation, Highland Park, Mich. 1957 ASME Gas Turbine Power Conference paper No. **57—GTP-10** (multilithographed; available to Jan. 1, 1958).

AN INVESTIGATION to determine the performance map of a compressor-driving turbine stage over its entire operating range was conducted by the Chrysler Corporation. The particular turbine stage considered in this investigation had a rated power output of 240 hp at a speed slightly in excess of 50,000 rpm with an inlet temperature of 1500 F. These are the conditions for maximum gas-power output, but the unit also must be able to maintain reasonable efficiencies at speeds as low as 20,000 rpm where the output is only about 12 hp, in order that idle fuel consumption be kept to a reasonable value.

The test variables are combined into working parameters and these are used to develop a convenient test procedure. Fixture equipment and specialized instrumentation for the determination of airflow, pressure and flow angle, temperature, torque, speed, and tip clearance are discussed.

The test procedure, results, and the following conclusions are given:

1 The parameter approach to turbine-stage performance evaluation provided, with certain limitations, a convenient method for combining the many variables involved. It also permitted correlation of test results obtained under a wide variety of operating conditions.

2 A test fixture was developed which provided good control of mechanical variables and was at the same time capable of accepting a variety of state configurations and types of instrumentation.

3 The determination of stage efficiency depends on many factors, each in itself demanding a high degree of accuracy. It is felt most desirable to employ at least two independent methods for evaluating this quantity.

4 Despite numerous calibrations and corrections applied to all measuring instruments, as well as the utmost care in their construction, the dependable accuracy band of such measurements is somewhat questionable. This is true especially of static pressure and total temperature, and to a lesser degree with total pressure, flow angle, and torque.

5 The turbine stage discussed displayed a 3.5 per cent excess in choke-flow parameter, some underturning in the absolute rotor discharge-flow angle, and a maximum total efficiency of approximately 88 per cent.

Influence of Working-Fluid Characteristics on the Design of the Closed-Cycle Gas Turbine, by S. T. Robinson, American Turbine Corporation, New York, N. Y. 1957 ASME Gas Turbine Power Conference paper No. **57—GTP-13** (multilithographed; available to Jan. 1, 1958).

INTEREST in the high-temperature gas-cycle reactor coupled with a closed-cycle gas turbine in a single loop as a means of utilizing the energy available from nuclear fission has been renewed recently. The components of a simple closed-cycle gas-turbine nuclear power plant are a turbomachinery set comprising a compressor and turbine connected to the load, a recuperator for the internal transfer of heat within the cycle, a sink, an off-gas system, and a reactor to provide thermal energy which is converted to mechanical work within the system. This investigation concerns the influence of working-fluid characteristics on the design of turbomachinery, the heat-transfer apparatus, and the off-gas system.

In a closed-cycle gas-turbine nuclear power plant, having a common gas as a reactor coolant and power-plant working fluid, the gaseous working fluid must be selected on the basis of its nuclear characteristics. A monatomic gas, helium; a diatomic gas, nitrogen; and a triatomic gas, carbon dioxide, were selected for investigation in this paper. Characteristics of these gases, and their effect on a plant of 5 mw electrical output and 30 per cent net efficiency, were studied.

Within the limits of this study it does not appear that the nature of the working fluid has any significant effect on power-plant efficiency.

Designing Thermocouples for Response Rate, by R. J. Moffat, General Motors Corporation, Warren, Mich. 1957 ASME Gas Turbine Power Conference paper No. **57—GTP-8** (multilithographed; to be published in Trans. ASME; available to Jan. 1, 1958).

CONSIDERABLE effort has been put into the study of the transient response of thermocouples. One reason for this is the growing interest in temperature-sensitive controls for jet engines. The advantage of a temperature-sensitive control is obvious—it controls by the variables which require control. The disadvantages are chiefly in the sensing element. An ideal sensing element would be instantly aware of any change in gas temperature, and would follow accurately the temperature no matter how rapidly it changed. Unfortunately, no such ideal sensing element is available. Anything which has mass requires a finite time to change its temperature, the length of time depends on its heat capacity and on how fast heat is being added to it. In terms of a thermocouple, or any other immersion element, this means that if the temperature of the gas is changing, the thermocouple will "lag" and not follow the change exactly. This lag is important in analyzing transient temperature records made on a test engine. The recorded trace represents thermocouple temperature, not gas temperature. Due to the "lag" there may be considerable difference between gas temperature and thermocouple temperature.

Gas-Turbine Generating Experience of West Texas Utilities Company, by A. R. Cox, West Texas Utilities Company, Abilene, Texas. 1957 ASME Gas Turbine Power Conference paper No. **57—GTP-11** (multilithographed; available to Jan. 1, 1958).

THIS paper describes West Texas Utilities Company's operating and maintenance experience with the two gas turbines on its system from December, 1952 to August 26, 1956. The No. 1 Unit, located at Fork Stockton, Texas, is an independent plant with a second unit to be placed in service in the spring of 1958.

The No. 2 Unit, located at Girvin, Texas, is an application of a combustion gas turbine to the cycle of an old steam plant.

Both of these units are simple-cycle-type gas turbines which require a minimum of cooling water and auxiliary equipment. The turbines are coupled directly to the axial-flow air compressors and drive the generators through reduction gears at 3600 rpm. The turbines are fired with natural gas as fuel and require 150-psi gas pressure at the throttle valve.

Tabulated operating and maintenance costs are included.

A New Single-Shaft 3000-Hp Gas Turbine Ideal for Mechanical Drive Application, by Joseph Yindra, Westinghouse Electric Corporation, Philadelphia, Pa. 1957 ASME Gas Turbine Power Conference paper No. **57—GTP-12** (multilithographed; available to Jan. 1, 1958).

THE 3000-hp single-shaft gas turbine built by the Westinghouse Electric Corporation, incorporates improvements and experience gained through construction and field operation of hundreds of thousands of hours. This turbine incorporates many new features.

Among these new features is its wide speed-range flexibility suitable for most compressor-drive applications while retaining the simplicity of a single-shaft design. It is small in size and low in weight, permitting installation in a limited area at a minimum of cost in foundation and buildings. A unitized structure consisting of gas turbine, driven apparatus, starting equipment auxiliaries and controls are all mounted on a common bedplate. This unitized construction keeps installation costs to a minimum because all integral piping and controls are included in one assembly. Only a minimum of external utility connections is required before the plant is ready for operation. This system also has a quick-starting feature that permits the gas-turbine power plant to reach operating speed in less than 3 min after purging. A minimum of operating personnel is required due to fully automatic protection and semiautomatic starting and stopping controls. The system is so arranged that it can be adapted to remote control. Low maintenance costs are another new feature of this system, because of simple compact reliable construction and maximum accessibility. The new 3000-hp gas turbine incorporates the split casing and simplified two-bearing construction which has proved itself on other company models.

A Generalized Presentation of Gas-Turbine Combustor Performance, by A. E. Norcen, Assoc. Mem. ASME, and W. T. Martin, General Electric Company, Cincinnati, Ohio. 1957 Gas Turbine Power Conference paper No. **57—GTP-5** (multilithographed; available to Jan. 1, 1958).

RATIONAL design procedures for gas-turbine combustors require extension of available engineering data and better understanding of the processes which take place in an operating combustion chamber. Fuel atomization and vaporization, chemical reaction, fluid flow with turbulent mixing, and heat transfer were studied by determination of their effect on both the flameholding, or stability, limits of combustor operation, and combustion efficiency.

Test data were obtained from a 4-in-diam combustion tunnel with a 3-in-diam can combustor using natural gas, ethylene, propane, or hydrogen as fuel. The objective of the experimental testing phase was to obtain combustor-performance data at conditions representing a wide range of combustion rates within the combustor.

For a combustor in which fuel atomization and vaporization processes do not appreciably influence performance, the stability limits and combustion efficiency may be expressed as functions of the dimensionless groups Prandtl number, Peclet number, based on flow velocity; Peclet number, based on laminar flame speed; and Mach number.

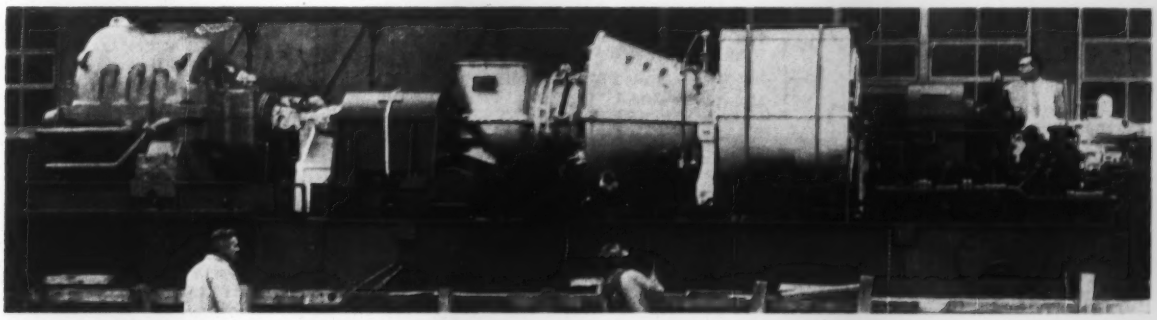
Those fluid-mechanical, heat-transfer, and chemical-reaction processes which are of importance to combustion efficiency, also determine combustor stability limits.

Laminar flame speed is a satisfactory index of the base combustion rate which influences combustor performance.

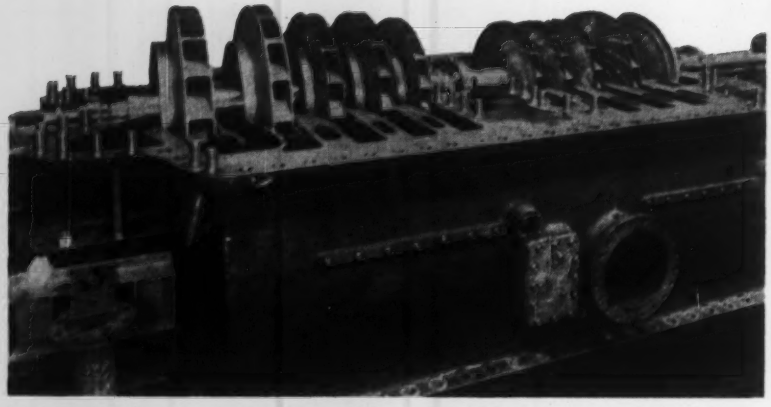
Design Features of New 16,500-Kw Gas Turbines for Power Generation, by A. O. White, Mem. ASME, General Electric Company, Schenectady, N. Y. 1957 ASME Gas Turbine Power Conference paper No. **57—GTP-1** (multilithographed; available to Jan. 1, 1958).

A DESCRIPTION is given of the design features of a 16,500-kw combustion gas turbine constructed by the gas turbine department of the General Electric Company. Units of this type will normally be directly coupled to 3600-rpm, hydrogen-cooled, 60-cycle generators of 17,647-kva capability at $\frac{1}{2}$-lb hydrogen pressure, and 22,049-kva capability at 30-lb hydrogen pressure. Other size generators, either air or hydrogen-cooled, can be provided to suit the purchasers' requirements.

The units will be the largest gas turbines built in the United States to date, and they will also be the largest simple-cycle, single-shaft machines in the world. While these simple-cycle units do not have the highest efficiency and the lowest fuel consumption attainable in a gas turbine, their compact size and simplicity result in the lowest building and installation costs, and offer an economical method of power generation for stand-by and peak load service, or where fuel costs are low.



New single-shaft 3000-hp gas-turbine power plant for mechanical drive application, built by Westinghouse Electric Corporation



Nine-wheeled isotherm compressor improves efficiency through interstage cooling in many stages with coolers built into the compressor. This compressor is effective in gas-turbine applications for the chemical industry.

Gas Turbines for the Chemical Industry, by Z. Stanley Stys, Assoc. Mem. ASME, Brown Boveri Corporation, New York, N. Y. 1957 ASME Gas Turbine Power Conference paper No. 57—GTP-9 (multilithographed; available to Jan. 1, 1958).

MANY chemical processes occur under pressure; the compressed medium supplied to such processes is usually air. In the majority of the processes the oxygen portion of the air is consumed, and nitrogen, somewhat polluted with the process products, is available. Since such processes occur under considerably elevated temperature, the end by-products are available at a temperature level quite suitable for applying a turbine-type expander.

In certain cases it is advantageous to supply additional heat to this cycle during the starting periods or to balance the power deficiencies in such cycles in order to make the driving units self-sustained, in so far as power input is concerned. For this purpose a combustion chamber for burning a gaseous or liquid fuel is used.

Since no hot gases are available at the beginning, an electrical motor or steam turbine is provided to start the unit and perhaps bring it over the surge point of the compressor, and operate it for a certain time until the chemical process is sufficiently "warmed up" to produce hot gases to supply additional power in the form of heat to the cycle. Since this power is never sufficient to drive the compressor, the starting motor or the steam turbine, as the case may be, supplies the deficiency of power. The ratio of the power generated by the gas turbine to the power supplied from outside, is 2 to 1 in the processes described in this paper.

It is apparent from this description that the application of the gas turbine in nitric-acid plants appears attractive. Several of these units have been installed recently in this country and performance and operating experience already have been gained. Design, construction, and layout of "package" units for this particular process are described in this paper.

Analytical Methods for Performance Estimates of Free-Piston Gasifiers, by A. R. Bobrowsky, Mem. ASME, Ford Motor Company, Dearborn, Mich. 1957 ASME Gas Turbine Power Conference paper No. 57—GTP-6 (multilithographed; available to Jan. 1, 1958).

PERFORMANCE-ANALYSIS techniques used by the Scientific Laboratory of the Ford Motor Company in order to estimate performance of free-piston gasifiers are given in this paper. Off-design operation is examined. Simple stability evaluations are made. Operation-dependent variables are obtained iteratively; for example, pressure drops, degree of afterburning, and so forth. The concept of minimum geometry is presented. Fields of operation are defined. Synthesis of control patterns is made relatively easy. Speedy approximations of frequency and performance may be made by procedures based on engineering-mechanism foundations.

Production Engineering

Production Engineering of Large Liquid-Fuel Rocket Engines, by K. K. Dannenberg, Army Ballistic Missile Agency, Huntsville, Ala. 1957 ASME Spring Meeting paper No. 57—S-11 (multilithographed; available to Feb. 1, 1958).

PRODUCTION engineering of large-size liquid-fuel rocket engines differs from the usual types of production engineering for the following reasons:

1 In rocket work, the production engineer does his re-engineering on a highly advanced item, instead of the "breadboard model" usually supplied in other areas.

2 The product is intricate; and minute changes might cause malfunctions or complete destruction in final use. In order to facilitate production, close cooperation between the production and research and development engineer is required.

3 The production rate, usually low, does not permit extensive retooling, complicated assembly fixtures, and the like.

4 Basic changes may be expected at any time, since the product is still deep in the research and development stage.

Despite the difficulties inherent in production engineering of rocket engines, the product must be prepared for its once-in-a-life-time mission. The production engineer must anticipate problems resulting from long storage periods; possibly unfavorable launch conditions; and ground personnel without the experience of having fired similar units.

A brief history of guided-missile development since the V-2 rocket is given to illustrate the problems of the production engineer.

Production Engineering of Solid-Fuel Rocket Motors, by E. C. Roberts, A. L. Couch, Jr., and R. D. Walker, Redstone Arsenal, Huntsville, Ala. 1957 ASME Spring Meeting paper No. 57—S-4 (multilithographed; available to Feb. 1, 1958).

THE application of production engineering to solid-fuel rocket motors does not differ substantially from that applied to any other form of mechanical ordnance device. The term "production engineering" as utilized by Ordnance, is extended to include a considerable amount of product design, field-maintenance criteria, and so on, most of which is not considered production engineering during the manufacture of commercial items.

To develop and produce an optimum weapon calls for research into new fields often resulting in new processes and uses for the various materials involved in weapon construction. In the design of a new weapon the emphasis is, of necessity, on how to achieve the necessary military characteristics. Many times there is no precedent to draw upon.

Production engineering is begun at the time the basic design of the item is finalized. Interchangeable parts and components have been established which

must be maintained, in so far as possible, due to problems and cost involved in maintaining spare parts in the field and to assist in the training of the using agency. Safety and reliability during use are the primary objectives; however, a change in design or method of manufacture to achieve these and other objectives often results in a decrease in cost sufficient to reimburse the cost of production engineering.

Fuels

Station Design Considerations in Evaluating Selection of Fuels, by W. E. Hopkins, Mem. ASME, Stone & Webster Engineering Corporation, Boston, Mass. 1957 ASME Spring Meeting paper No. 57—S-14 (multilithographed; available to Feb. 1, 1958).

CHANGING conditions relative to the availability and price of fuels have made it necessary to evaluate carefully the selections of present and future fuels for steam-electric power plants.

Basic design characteristics of a generating station are important factors in the evaluation of alternate fuels. Although individual study and analysis are required for each proposed installation, it is possible to generalize certain design factors which must be considered in evaluating the selection of fuels.

This paper discusses fully each of the following items to be considered when selecting fuels: Site, station layout, generating capacity, reliability, maintenance, investment, and annual operating cost. Coal, residual oil, and natural gas fuels are considered in this paper.

Pulp-and-Paper-Mill Trends Toward Integrating Power and Bark-Burning Boilers, by L. P. Copian, Assoc. Mem. ASME, Riley Stoker Corporation, Worcester, Mass. 1957 ASME Spring Meeting paper No. 57—S-13 (multilithographed; available to Feb. 1, 1958).

BARK burners were principally used for bark disposal. Bark was burned either in a furnace of its own or in a small auxiliary furnace attached to a main boiler furnace. Primary fuels were coal, oil, or gas, and the Btu derived from bark burning were used to supplement the standard fuels.

Within the past 10 years the reliability of wood-refuse-burning units has improved to the point that many mills are generating high-pressure, high-temperature steam for feeding to the turbine-generator units. The capacities of the larger of these units exceed 300,000 lb per hr with pressures and temperatures in the 1200-psig, 950-F ranges, respectively.

The major factor in producing this trend is the development of reliable bark-handling and firing equipment that permits continuous firing of the refuse and continuous removal of ashes, obviating manual furnace cleaning and its attendant furnace down-time; also the application of rugged automatic controls has been of major importance—particularly in regard to the application of auxiliary fuels. In addition to providing automatic operation of the boiler when firing bark refuse, automatic controls regulate the required proportions of auxiliary fuel as the rate of bark firings changes.

There are several respects in which the integration of bark burner and power boiler can result in cost saving to the mill:

1 Less ground space is required when one large boiler combines the foundations of two smaller units.

2 A single set of auxiliary equipment, pumps, fans, automatic controls, and so on, is required.

3 Maintenance is confined to a single unit rather than to two separate units.

4 Operating personnel is limited to that needed for only one boiler.

Heat Transfer

Promotion of Dropwise Condensation of Several Pure Organic Vapors, by R. P. Bobco, Assoc. Mem. ASME, and A. I. Gosman, Assoc. Mem. ASME, Northrop Aircraft Company, Hawthorne, Calif. 1957 ASME Spring Meeting paper No. 57—S-2 (multilithographed; available to Feb. 1, 1958).

THE phenomenon of dropwise condensation has been known for more than 25 years and is well cataloged in mechanical and chemical-engineering literature. It has, however, never been observed to occur with any degree of reproducibility for any pure vapor except steam. Dropwise condensation of various mixtures of steam and organic vapors are reportedly commonplace, but conclusive evidence of dropwise condensation for pure organic vapors heretofore has been unavailable.

Investigations comparing heat-transfer rates of dropwise and filmwise condensation of steam indicate that dropwise condensation gives coefficients of heat transfer 2 to 8 times as high as film condensation. The higher rates for dropwise condensation are understandable inasmuch as with a given temperature difference a large portion of the condensing surface is free of condensate that otherwise acts as an insulating film.

The usual manner of assuring dropwise condensation of steam is to coat the condenser surface with several monolayers of a promoter. The fatty acids, mercaptans, light lubricating oils, and others. These substances exhibit a strong affinity for various metals, becoming adsorbed onto the surface, and offering a low surface tension to water vapor.

This paper describes the results achieved in inducing dropwise condensation of iso-octane, ethanol, carbon disulfide, and several other organic substances through the use of various fluorochemicals as promoters. Although no heat-transfer data are available, the question of the practicability of using these promoters is discussed.

A Simplified Method for the Study of Two-Dimensional Transient Heat Flow Using Resistance Paper, by A. V. Clark, U. S. Naval Research Laboratory, Washington, D. C. 1957 ASME Spring Meeting paper No. 57—S-9 (multilithographed; available to Feb. 1, 1958).

A DESCRIPTION is given of a method developed at Bell Aircraft Corporation for the study of two-dimensional transient-state heat flow by electrical analogy. The particular analogy which applies to resistance paper is presented and an experimental check was run to verify the theory.

The resistance paper is a two-dimensional resistor and the paper is connected into a circuit. The paper is available in resistances of 2500, 10,000, 20,000, and 40,000 ohms per square. All squares of the paper, no matter what the size, will have the same resistance when the resistance is measured between conductive strips (silver paint) on opposite sides of a square. The lines on the paper are painted with a silver paint and are along lines of equipotential.

This electrical-analogy method uses the resistance paper for the resistors and capacitors of equal value in the circuit for an analogy to heat transfer. In developing the electrical-analogy method, the mathematics are included to show the analogy between heat flow and electrical-current flow.

This method for the study of two-dimensional heat-flow problems has several advantages: Inexpensive equipment; electrical model construction is easy and requires little time; little experience is needed to understand and be able to run a test.

Free Convection From Heated Surfaces—Laminar Boundary Layers, by J. Rutkowski, Wayne State University, Detroit, Mich. 1957 ASME Spring Meeting paper No. 57—S-7 (multilithographed; available to Feb. 1, 1958).

THE free-convection boundary-layer

problem for a heated vertical surface is treated in an approximate manner by considering the temperature profile as essentially due to conduction alone, and the velocity profile due to this temperature distribution and to viscosity. Using these relations for the profiles, expressed in terms of error functions, the energy and momentum equations are solved using the integral approach. The calculated velocity and temperature distributions and heat transfer are compared with those obtained by other methods and with experimental results. Extensions of this approach are made to parallel surfaces, cylinders, and spheres.

Management

Control of the Engineering Functions in a Decentralized Company, by G. F. Habach, Mem. ASME, Worthington Corporation, Harrison, N. J. 1957 ASME Engineering Management Conference paper No. **57—MGT-1** (multilithographed; available to Jan. 1, 1958).

THE basic organization of a decentralized company and the function of the engineering department at the operating level are outlined. Research, development, design, drafting, technical-assistance counseling, training, and other necessary activities are the tools which permit an engineering department to fulfill its function. This function is to contribute to the profitable development, production, and sale of products which will serve the needs of the customers by providing better performance at lower costs. The necessity for the engineering department to have maximum freedom is considered, but the necessity for control of activities in order to achieve over-all co-ordination of company activities is also noted. A headquarters engineering organization is described and its relation to the divisions is discussed with the objective of showing the nature of controls that can be established. The value of product control, to provide for maximum performance of current products and development of new products, and personnel control, to provide, train, and maintain adequate and competent engineering personnel and facilities, is discussed briefly.

Tailoring a Training Program to Company Needs, by C. A. Jurgensen, Mem. ASME, De Laval Steam Turbine Company, Trenton, N. J. 1957 Engineering Management Conference paper No. **57—MGT-3** (multilithographed; available to Jan. 1, 1958).

BUILDING and maintaining an adequate and competent management is one of the basic problems concerning management today. Current management and development programs are not always producing the desired effects. This paper suggests a plan of action for obtaining better results from such programs:

1 Top management must take an active part in developing a program, if one does not exist, and improving it if one does exist.

2 State a policy of training and development and operate the program in terms of the needs of the specific company.

3 Review the effectiveness of all elements of the program and drop those elements that seem ineffective.

4 Place top emphasis on development through the individual's job assignments, counseling, and job-performance checking.

5 Add supplementary training to aid the individual's growth, broaden his knowledge, and improve his perspective.

6 Integrate the training and manpower-development program to other functions such as product development, sales promotion, and so on.

Control of Research and Development to Meet Company Objectives, by A. Wexler, Westinghouse Research Laboratories, Pittsburgh, Pa. 1957 ASME Engineering Management Conference paper No. **57—MGT-5** (multilithographed; available to Jan. 1, 1958).

THE objective of administrative control of a research and development effort is to optimize the total return on the research and development dollar. The author suggests that a policy of guidance instead of rigid control might prove more satisfactory for achieving this end. Guidance provides for the establishment of an environment in which the researcher can work happily, and relies on an administrative staff with sufficient technical and administrative ability to pinpoint the important research and development problems and to provide the lubrication and feedback which are needed in leading the researcher toward fulfilling company objectives.

Systems Design for Production-Control Data Processing, by W. L. Murdock, Consultant, New York, N. Y. 1957 ASME Management Conference paper No. **57—MGT-6** (multilithographed; available to Jan. 1, 1958).

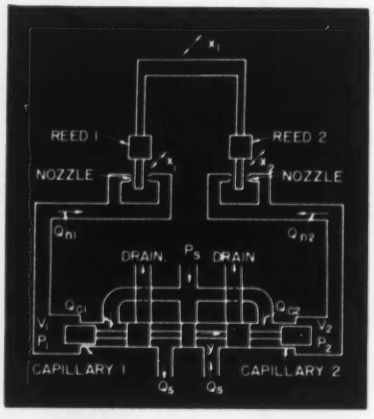
A DISCUSSION is given of an appropriate organization to maintain the information structure of an industrial operation. The effectiveness of operations research to reduce production-control explosion costs is illustrated by an example. A simplified description of the machine techniques is given. A cost comparison is given of manual methods, conventional punched-card techniques in common usage, and the punched-card techniques produced by the operations research study. It is contended that efficient machine techniques are rooted in a thorough systems study at all levels of management of the operation being served and controlled.

Instruments and Regulators

Dynamic Response Study of a Mechanical-Hydraulic Frequency-Discriminator Governor, by C. C. Christianson, General Electric Company, Schenectady, N. Y. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-14** (multilithographed; available to Feb. 1, 1958).

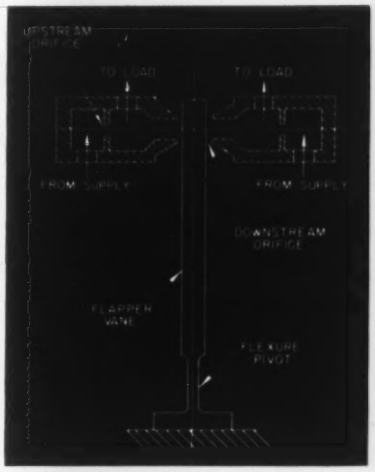
THE search for new and better speed or frequency sensing devices is a never-ending one. Most present-day aircraft alternator prime movers use either a flyball governor or an electrical frequency discriminator as a speed sensor. Flyball governors present problems of mechanical backlash, friction, and temperature sensitivity. Electrical frequency discriminators usually require amplifiers as well as electromechanical transducers, such as solenoids. The mechanical-hydraulic frequency-discriminator governor analyzed in this paper uses the principle of the electrical discriminator while eliminating the need for any electrical signals.

The frequency-response characteristics



Schematic of mechanical-hydraulic frequency-discriminator governor. Input to the governor is a sinusoidal mechanical motion of constant amplitude, but of variable frequency.

of a mechanical-hydraulic frequency-discriminator governor are determined analytically and compared with experimental results. The working parts of the governor include two frequency-modulated resonant reeds and a spool valve. Special emphasis is placed on the determination of the transfer function between input frequency and output amplitude of the frequency-modulated reed. Mathematical analysis similar in principle to that used in a-c synchronous-machinery theory (Park's equations) led to nonlinear equations describing the frequency-modulation characteristics of a resonant reed. Linear transfer functions for the frequency-modulated reeds and hydraulic portion of the governor are obtained by use of small perturbation theory. Reasonably good correlation is obtained between the calculated and measured over-all frequency response of the governor.



Configuration of linear force-input, pneumatic amplifier with fast response characteristics

A Linear Force-Input, Pneumatic Amplifier With Fast Response Characteristics, by T. E. Hoffman, Massachusetts Institute of Technology, Cambridge, Mass. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-4 (multilithographed; available to Feb. 1, 1958).

A FORCE-INPUT pneumatic amplifier has been designed at the Dynamic Analysis Laboratory, M.I.T., to fill the particular needs of a depth controller for straight-running, air-driven torpedoes. This amplifier was designed to fill the specific requirements of fast response, negligible hysteresis, linearity, and freedom from friction. The output of this amplifier is a high-level differential pressure.

The program for the design of the pneumatic amplifier was undertaken in three successive phases. During the first phase of the program, the optimum configuration for the depth controller was obtained by means of analog-computer techniques that were used in conjunction with an analog simulation of the torpedo hydrodynamics. In the second phase, the design of the components for a breadboard model of the optimum configuration was undertaken. The third phase was the construction of a reliable prototype suitable for quantity production; it is still in progress.

The general configuration of the pneumatic amplifier is a bridge with fixed upstream orifices and downstream orifices that are varied differentially by a flapper vane.

The physical arrangement of the amplifier is such that the flapper vane is an integral part of the pitch-rate-gyro gimbal; thus the gyro torque is applied directly to the gimbal. The gimbal is suspended on flexure pivots that, owing to the restricted movement of the vane, operate well within the elastic region of the flexure material and, hence, are essentially free from hysteresis and friction. The depth and depth-rate signal forces are applied to the gimbal in such a way that the net force on the flapper vane at the nozzle radius is the correctly proportioned sum of the three signal variables. A static gain factor common to all three signals is obtained in the pneumatic amplifier. The pneumatic amplifier is unstable and, therefore, requires external damping. The damping is supplied conviently by the dashpot that generates the depth-rate signal.

Mathematic analysis of the static and dynamic characteristics of the amplifier is given.

Practical Aspects of Relay or Pulse Servomechanisms, by H. Adkins, Detroit Arsenal, Center Line, Mich. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-5 (multilithographed; available to Feb. 1, 1958).

THERE is a growing need for servomechanisms in tanks and ordnance vehicles. The lack of a-c power, and the requirements for low stand-by power, very high efficiency servomechanisms have directed development toward the relay power-amplifier type. Higher power servos for turret and gun direction have taken the form of hydraulic and amplidyne types.

This paper discusses the power-type servos ranging from a milli-horsepower peak to several horsepower. The efficiency on typical units is about 40 per cent which is much higher than most a-c servos. The very high starting torques of series-wound d-c motors enables them to handle large inertial loads. Some have analyzed this type of servo using the infinite gain-large dead-zone approach, however, most of the work done by the author has been on a trial-and-error basis, plus the experience gained by developing and servicing systems.

The components, system, and system characteristics of several pulsing servomechanisms used for ordnance vehicles are discussed in this paper. The systems are divided into three categories: (*a*) The pulse occurrence depending upon an error; (*b*) continuous pulse occurrence with the duration in either direction dependent on error (zero duration for zero error); (*c*) continuous full bidirection pulses with duration unbalance for correction. Proportional systems and d-c pulse systems are compared on an efficiency and weight basis. Examples of computer, gun pointing and stabilizing, and control pulsing systems are given.

Statistical Treatment of Sampled-Data Control Systems for Actual Random Inputs, by M. Mori, Institute of Industrial Science, University of Tokyo, Chiba City, Japan. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-10 (in type; to be published in Trans. ASME, available to Feb. 1, 1958).

FUNDAMENTAL statistical relations of sampled-data systems in terms of the correlation functions of time series, the pulse spectral densities, and the modified z-transform are presented. If one is interested in signals between sampling instants, the modified z-transform method can be applied easily to the statistical treatments, as are presented in the paper. The relation between this method and the analysis on the basis of variable-system theory is proved. Examples are given discussing discrete compensation of a sampled-data control system from the statistical standpoint.

Design of Multivariable Optimum Filters, by J. H. Westcott, Imperial College, London, England. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-11 (in type; to be published in Trans. ASME, available to Feb. 1, 1958).

THE paper considers in detail a case of multivariable optimum filter design which is of engineering interest. This is the problem of extracting the best resemblance, in a minimum mean-square-error sense, of a message available in differently corrupted forms from a number of sources, given the statistical charac-

teristics of message and disturbances. The solution is shown to involve an essential difference from the familiar case for a single source. Other multivariable optimum studies are not in principle different from the one considered here and consequently require the same type of analysis. A numerical example of the design of the optimum combination of filters for deriving a message from two noisy sources is given.

Dynamic Field Tests of a Steam Turbine, by P. R. Hoyt, B. D. Stanton, and D. C. Union, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-15** (multilithographed; available to Feb. 1, 1958).

EXPERIMENTAL frequency-response data are presented on a 3000-hp steam turbine in a typical continuous process installation. The process equipment consisted of what was considered to be a critical series-parallel installation of four turbine-driven compressors. The compressors increased propylene feed pressure from 13 to 625 psia in two stages. The steam turbine discussed in this paper drives one of the second-stage compressors.

The cascaded pressure-speed control system was the second such installation put in by the author's company. The process pressure had to be held closely to the set point pressure, the compressors had to be prevented from surging, and the turbine compressors had to be prevented from overspeeding. Also, they were to be prevented from reversing upon steam shut-off or failure, which would allow the compressor to drive the turbine backwards. The check valves prevent reversal.

Open-control-loop tests were made and the results used to predict the closed-control-loop results, which also were measured. The dynamics are discussed qualitatively.

An Analog Study of a High-Speed Recording Servomechanism, by J. W. Schwartzenberg, Leeds & Northrup Company, Philadelphia, Pa. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-9** (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

THIS paper presents an analysis of a high-speed recording servomechanism. Because of the nonlinearities present, the system is simulated on an analog computer. Minimum balancing times with a 100 per cent step-input signal are obtained for various combinations of system parameters. Several types of damping are considered, and the a-c carrier action of the amplifier is included in the simulation. The frequency response and following error of the system are also considered.

Correlation Functions and Noise Patterns in Control Analysis, by H. Thal-Larsen, Mem. ASME, University of California, Berkeley, Calif. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-6** (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

THIS paper describes the interplay of disturbance patterns and correlation functions when "noise" enters a control system, both in the fictitious case of the mathematical model and in the real process. In pointing out this interplay in the model and again in the real process, the application of correlation functions to control analysis is shown to have its limitations. At the same time the importance of discovering equivalent disturbance patterns is emphasized and a procedure for their discovery is developed.

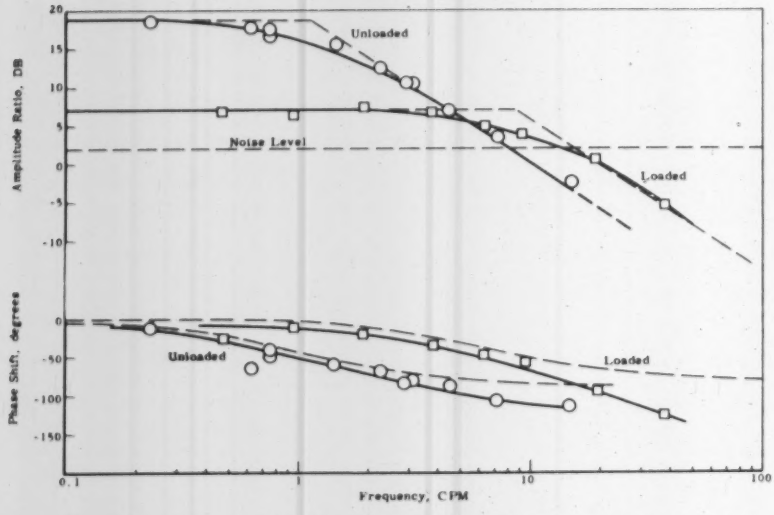
Analysis of the Transient Response of Nonlinear Control Systems, by P. E. W. Grensted, University of Cambridge, Cambridge, England. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-8** (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

THE calculation by a new analytical method of the transient response of nonlinear control systems is described. If the response is oscillatory, it is possible to obtain expressions for the variation with time of the frequency and amplitude of the oscillation. The response of a servomechanism containing marked saturation, backlash, and Coulomb friction has been analyzed successfully.

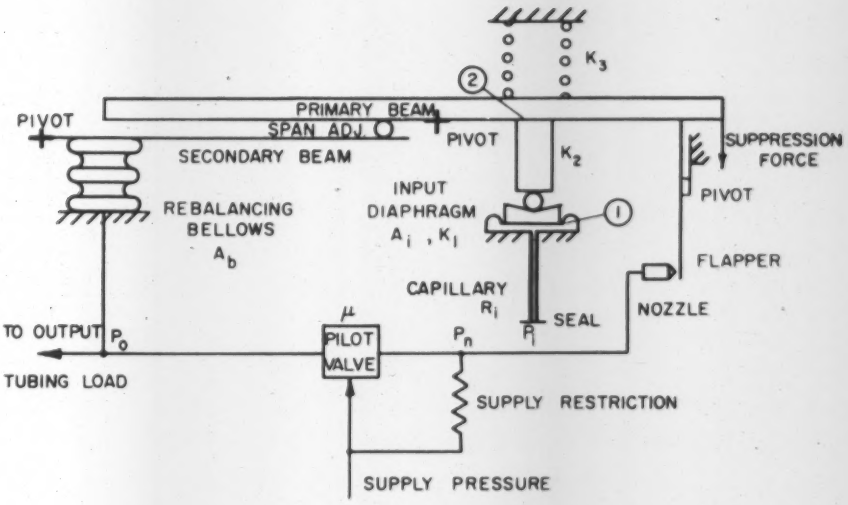
Dynamic Field Tests of a Process Furnace, by P. R. Hoyt, B. D. Stanton, and D. C. Union, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-16** (multilithographed; available to Feb. 1, 1958).

EXPERIMENTAL frequency-response data are presented on a thermal furnace. The subject furnace, a very old one already loaded beyond capacity, offered an excellent opportunity for exploration with dynamic-response techniques to determine if automatic controls would increase profits from the plant of which it is a part. At that time the temperature of the product transfer line out of the furnace varied ±10 F, caused by disturbances which could not be controlled manually.

The furnace was tested by frequency-response methods to obtain the dynamic transfer functions between the several variables. With these transfer functions, it was possible to design an appropriate control system; and with these experimentally derived transfer functions as validating evidence that the control system design was sound, the system was approved and installed. Within one month of operation, the $7500 capital investment in control equipment was paid out by increased profitability.



Open-loop frequency responses for the turbine coupled under full load and uncoupled as determined in dynamic field tests of a steam turbine



Schematic diagram of pneumatic process-pressure transmitter. The transmitter, a pneumatic force-balance device, senses a process pressure and transmits a pneumatic signal proportional to the measured variable. Its output pressure depends upon the mechanical span and suppression adjustments.

Dynamic Study of an Experimental Pneumatic Process-Pressure Transmitter, by E. F. Hochschild, Assoc. Mem. ASME, General Electric Company, Philadelphia, Pa. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-7 (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

A DYNAMIC analysis and synthesis study of a highly accurate pressure-measuring instrument are presented. Emphasis is placed on methods, techniques, and the experience gained during the course of the investigation. Use of network theorems and the mobility method permits a simple analysis of a complex mechanical-pneumatic device. The effects on the transmitter resulting from tubing load are treated in detail. An electronic analog simulation, incorporating a transmitter nonlinearity, is used in the final synthesis for obtaining the required dynamic performance. Experimental and calculated frequency responses are compared and excellent correlation is shown.

Algebraic Approach to Design of Automatic Controls, by R. Oldenburger, Mem. ASME, Purdue University, Lafayette, Ind. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-2 (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

THE solution of linear problems in automatic control is generally reduced to the study of ordinary differential equations and thus to characteristic equations, which are algebraic. It is then necessary to solve an algebraic equation to predict the transients for a given controlled system. Whether or not the system is stable can be determined from the simple test of Routh. Because of the great difficulties encountered in the past in solving algebraic equations, especially in the case of all roots complex, resort has been made to qualitative methods of automatic control design based on frequency response and other techniques.

The author applies to algebraic equations for stable systems certain procedures, including a right to left synthetic division, which enable the engineer to approximate some of the roots, after which the solution for all of the roots can be obtained readily. From the roots, the analyst can tell what the transients will look like. Good transients are necessary for good control. The author's method, in use at the Woodward Governor Company for several years, is applied to the design of a governor for a gas turbine.

Multipliers for Nonlinear, Compensation of Control Systems, by D. Lebell, Ramo-Wooldridge Corporation, Los Angeles, Calif. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-1 (multilithographed; available to Feb. 1, 1958).

SEVERAL approaches to nonlinear compensation of control systems require multiplication of two variables. A proposal for utilizing the inherent multiplier of power transducers has been cited for electrical, hydraulic, and pneumatic power elements. Its application to an aircraft-type instrument servo has been made. Dynamic performance of this servo is shown to be superior to that of the conventional system.

This improvement in system performance comes at the cost of providing nonlinear control at two power inputs rather than one. For the induction motor considered in some detail in this paper, this means that amplified control signals must be provided at both motor windings. Hence, improved performance is achieved at the expense of greater system complexity than is required for the linear design.

Design of a Self-Optimizing Control System, by R. E. Kalman, Columbia University, New York, N. Y. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-12 (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

THIS paper examines the problem of building a machine which adjusts itself automatically to control an arbitrary dynamic process. The design of a small computer which acts as such a machine is presented in detail. A complete set of equations describing the machine is derived and listed; engineering features of the computer are discussed briefly. This machine represents a new concept in the development of automatic control systems. It should find widespread application in the automation of complex systems such as aircraft or chemical processes, where present methods would be too expensive or time-consuming to apply.

Some Dynamics of the Golf Shot, by A. J. Williams, Jr., Mem. ASME, Leeds & Northrup Company, Philadelphia, Pa. 1957 ASME Instruments and Regulators Conference paper No. 57—IRD-13 (multilithographed; available to Feb. 1, 1958).

THIS work has been aimed at finding and explaining the obscure influence causing a persistent tendency by a golfer to "slice" or "hook" his golf shots.

Photographs and descriptions are presented for the special golf clubs and measuring devices used to determine mechanical quantities pertaining to the dynamics of the golf clubs, such as force, position, velocity, angular velocity, and so on. Two possible locations for the obscure influence and its nature in each location have been studied through the analysis of the mechanical quantities measured. One location is in the forward path and the other location is in the feedback path involving the golfer.

Optimization of Time-Varying Linear Systems With Nonstationary Inputs, by M. Shinbrot, National Advisory Committee for Aeronautics, Moffett Field, Calif. 1957 ASME Instruments and Regulators Conference paper No. **57—IRD-3** (in type; to be published in Trans. ASME; available to Feb. 1, 1958).

A METHOD is presented for solving the integral equation which arises in optimization problems with nonstationary inputs. Since systems with nonstationary inputs are usually time-varying if they are optimum, this paper begins with a brief discussion of time-varying systems. The consideration of the integral equation for the optimum follows, and the solution of this equation when the noise is white is given. The method of solution depends upon the correlation functions being of a certain type—fortunately, a type which arises frequently in practice. The sort of problem which can be handled and the associated results are illustrated by examples.

Machine Design

Design of Warped Buckets for Optimum Efficiency, by W. H. Wiebe, De Laval Steam Turbine Company, Trenton, N. J. 1957 ASME Spring Meeting paper No. **57—S-1** (multilithographed; available to Feb. 1, 1958).

IF A turbine stage with straight nozzle and bucket profiles is designed for a given enthalpy change so that the velocity ratio in the pitch line assures the best diagram efficiency, it will have lower efficiency above and below the pitch line. This becomes more pronounced with increasing bucket length, and it is, therefore, the general practice to abandon the less expensive straight profiles in favor of warped designs if the bucket length surpasses a certain value in relation to the diameter of the wheel. A warped stage takes into account an increase in reaction along the length of the bucket from root to tip in relation to the varying velocity ratios.

Steam flow and design criteria of axial turbine stages with warped buckets are discussed in this paper. Two principles of design and methods of calculation are discussed: for balanced or equilibrium flow, and for optimum diagram efficiency. An empirical relation is introduced for the first method which enables the differential equation for balanced flow to be integrated over the whole blade length with sufficient accuracy. In the second part the differential equation for optimum efficiency is solved for the determination of the reaction, which in turn permits the design of velocity diagrams for any blade sections. For all above derivations suitable dimensionless variables are introduced.

Characteristics of Unevenly Underlapped Four-Way Hydraulic Servo Valves, by Tsun-Ying Feng, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn. 1956 ASME Annual Meeting paper No. **56—A-140** (multilithographed; available to Oct. 1, 1957).

VALVE underlap has long been known as an effective means of stabilizing servo systems. The stand-by power loss, however, incurred by the valve underlap often becomes intolerable in high-performance hydraulic servomechanisms. Recent engineering effort has been concentrated on minimizing the stand-by power loss while simultaneously obtaining the dynamic stability of the control systems. With this objective, there originated the idea of using an unevenly, underlapped four-way valve.

The two most important characteristic quantities of such a valve are valve gain and valve conductance. Their derivations are based on the small perturbation method. The validity of using the perturbation method in studying these quantities is verified by over-all valve characteristic curves. The two quantities are compared between unevenly underlapped valves and evenly underlapped valves. A control system which employs an unevenly underlapped four-way valve is studied, and its feasibility illustrated.

Techniques of Drawing in the Third Dimension, by D. Gordon, Consulting Engineer, Bridgeport, Conn. 1957 ASME Spring Meeting paper No. **57—S-5** (multilithographed; available to Feb. 1, 1958).

MORE than 2000 years ago, Euclid formulated the theory that each eye sees a different picture of a scene. Thus the awareness of depth perception has long been known. From that beginning, an unknown observer discovered the beginning of the art of stereoscopy.

Stereoscopic practice, in one form or another, is apparent in the stereoscopic drawings of the artists of the 16th Century. How these drawings were made and by what method they were viewed are not too well known.

The application of the stereoscope through the use of mirrors was made by Wheatstone in 1838 for the purpose of viewing such stereoscopic drawings. Soon afterward, with the appearance of photography, this stereoscope was used for viewing the stereoscopic photographs. Later, the Brewster stereoscope for "separating" the pictures through the use of prisms, appeared. The parlor, or the Oliver Wendell Holmes, stereoscope became popular in homes throughout the world.

Then, complicated geometric drawings were made for fusion into third-dimensional space. In 1941, Prof. John T. Rule, of The Massachusetts Institute of Technology, wrote the authoritative "Geometry of Stereoscopic Projection." Finally today, stereo for motion pictures, photography, and drawings in all forms has taken on a new mode.

This paper describes a new method of mechanical drawing in the third dimension which might be of use in produce and machine design. A method of viewing the third-dimensional mechanical drawing is also described.

Impact Stresses in Drop-Hammer Guides, by F. Koenigsberger, Mem. ASME, Manchester University, Manchester, England, and S. R. Ghabrial, Cairo University, Cairo, Egypt. 1956 ASME Annual Meeting paper No. **56—A-12** (multilithographed; available to Oct. 1, 1957).

ONE of the causes of cracks occurring in drop-hammer guides is the development of high stresses due to side thrusts of the tup, often aggravated by the existence of stress raisers—a condition which is particularly liable to occur in unsuitable welded designs. Strain measurements on two scale models of a typical hammer guide and on an actual hammer guide during forging operations showed that the stresses in the hammer guide—particularly those caused by "off-center" blows—are similar to those produced in the models under transverse-impact loading. The magnitude and rate of strain are proportional to the impact velocity. The magnitude and location of the maximum stresses can be greatly influenced by the fixation conditions and can be reduced by the provision of elastic members between the guide top, on the one hand, and the tie-bolt nut and the spreader, on the other hand.

Development of the Natco Feed-Rate Indicator, by R. A. Schafer, Mem. ASME, and V. E. Tice, National Automatic Tool Company, Inc., Richmond, Ind. 1957 ASME Spring Meeting paper No. **57—S-6** (multilithographed; available to Feb. 1, 1958).

IMPROPERLY set feed rates cause excessive tool wear, increased down time, and decreased production. A direct-reading electronic feed-rate indicator, presenting an instantaneous reading, would facilitate fast and accurate machine setups.

Natco has developed such an instrument, primarily for use in the setting of hydraulic feeds on machine tools.

The feed-rate indicator has a potentiometer stroke length of 4 in., two feed-rate ranges, 0-10 ipm and 0-50 ipm. Power is obtained from self-contained batteries, making the unit entirely portable.

This instrument has been applied to many different types of machines and found indispensable in both initial feed-rate settings and frequent checks to maintain proper feed rates. The feed rate of a machine can be checked easily without interfering with production, since the pickup can be placed on the machine and the feed rate read in a matter of seconds. Hydraulic traverse-governor response can be checked easily. Feed rates on all types of machines may be observed while machining is actually being done.

A Simple Formula for Determining the Position of Maximum Slider Velocity in a Slider-Crank Mechanism, by Ching-U Ip, Assoc. Mem. ASME, and L. C. Price, Mem. ASME, Michigan State University, East Lansing, Mich. 1957 ASME Spring Meeting paper No. **57—S-8** (multilithographed; to be published in Trans. ASME; available to Feb. 1, 1958).

A CUBIC equation which gives the position of maximum slider velocity is derived. The equation lends itself readily to be solved to any desired degree of accuracy by Lin's method. A simple formula is found to furnish a closed-form answer which is accurate to within 4 min of a degree for l/r ratio of 1.5, and has practically no error for l/r greater than 5. The results are compared with those obtained from the familiar approximate slider-velocity formula having a second harmonic.

Undercutting of Spur Gear Teeth, by G. H. Martin, Mem. ASME, Michigan State University, East Lansing, Mich. 1957 Spring Meeting paper No. **57—S-3** (multilithographed; available to Feb. 1, 1958).

IN THE generation of spur gear teeth either by a hob or a gear shaper, it is known that when a relatively small number of teeth are cut, a portion of the involute profile is removed. This is known as undercutting, and adversely affects the performance of the gear.

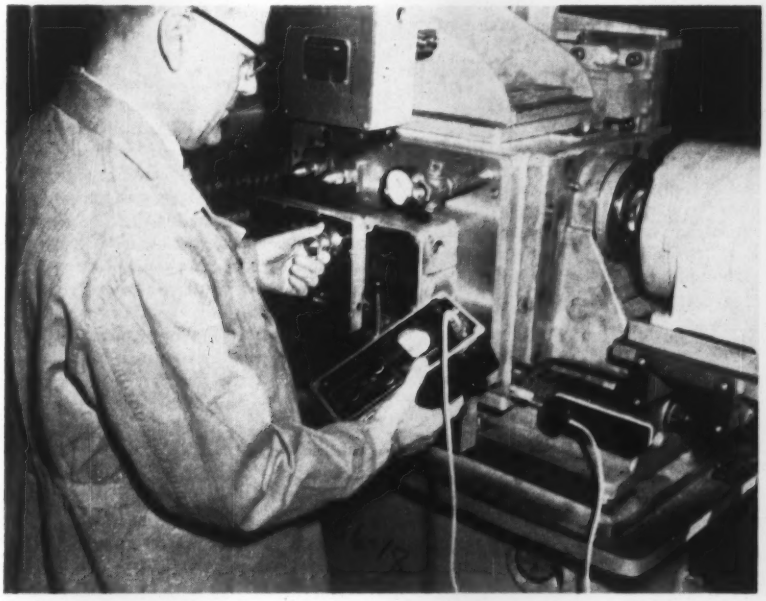
Undercutting on a pinion, even a slight amount, greatly reduces the interval of contact for the pinion tooth and its mating gear tooth. This can result in larger loads on the teeth, producing higher contact stresses and bending stresses in the teeth as well as a reduction in the smoothness of operation. In practice, sufficiently accurate determinations of the extent of undercutting have been made from large scale layouts on which the intersecting involute and trochoidal curves have been generated with the aid of a template of the cutter tooth.

In this paper the theory of complex functions is used to determine the amount of undercutting produced by a hob and also by a gear shaper.

A Million Pound High-Speed Dynamic Fatigue-Test Machine, by Gregory Flynn, Jr., and A. F. Underwood, Mem. ASME, General Motors Corporation, Detroit, Mich. 1956 ASME Annual Meeting paper No. **56—A-145** (multilithographed; available to Oct. 1, 1957).

THE General Motors Research double-acting hydraulic fatigue-test machine, designed for a load range of one million pounds, was developed and built when the loads required to test locomotive diesel pistons exceeded the capacity of the existing test machines. This machine was designed to provide loads of 500,000 lb in both tension and compression. A brief history of this type machine is given with a complete explanation of its working principles and operation.

Complete evaluation of full-scale parts prior to engine or vehicle testing in the GMR hydraulic fatigue-test machine has completely diminished costly failures resulting from fatigue, and has proved to be a great aid to the designer.



Feed-rate indicator in use on a hydraulic drilling machine. The pickup unit which houses a linear potentiometer is held to the machine ways by a permanent magnet. As the tool slide moves forward, a push-pull rod, which is attached to the tool slide by a permanent magnet, moves the potentiometer contact within the pickup.

Applied Mechanics

Dislocation Over a Bounded Plane Area in an Infinite Solid, by L. Rongved, Bell Telephone Laboratories, Inc., Murray Hill, N. J. 1956 ASME Annual Meeting paper No. **56—A-53** (in type; to be published in the *Journal of Applied Mechanics;* available to Oct. 1, 1957).

THE Papkovitch functions are determined for an infinite isotropic elastic solid with an arbitrary displacement discontinuity over a bounded plane area. A solution, in closed form, is given for the case of a constant discontinuity in the displacement over a rectangular area.

Process Industries

Spray-Dryer Design Calculations, by M. Doumas, Assoc. Mem. ASME, Westinghouse Electric Company, Pittsburgh, Pa., and A. Huste, General Foods Corporation, Hoboken, N. J. 1956 ASME Annual Meeting paper No. 56—A-186 (multilithographed; available to Oct. 1, 1957).

THE operation of a spray dryer is intended to recover in a powder form the solids present in a solution or suspension. The liquid to be dried is atomized into a heated gas stream flowing through the drying chamber. The function of the gas stream is to supply the heat needed for evaporating the solvent from the liquid and also to act as a carrier for the evaporated solvent. Each droplet of the atomized liquid dries to produce a particle of the finished product, and these particles are separated from the gas stream by various types of dust collection equipment. Physical characteristics of the product such as density, particle size, color, and rate of solubility may be changed by varying dryer operating conditions.

A technique for calculating the size of a spray dryer required to dry a given drop size is presented. Basically, this technique involves calculating the trajectory of the drop through the air stream while simultaneously estimating the water-evaporation rates from the drop. The mechanism of drying of the drop, and the effects of changes in dryer operating conditions, are discussed as a basis for the assumptions used in the calculations.

Analysis of a Process-Fluid-Flow Network by Electrical Analogy, by C. F. Kayan, Mem. ASME, and J. A. Balmford, Columbia University, New York, N. Y. 1956 ASME Annual Meeting paper No. 56—A-187 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

IN A process-fluid-flow network of numerous interconnected branches of different proportions, the determination of the flow distribution by calculation is difficult because of the pressure-drop versus flow-rate characteristics of each individual component of the complex. Not only does the pressure-drop vary with the effective pipe dimensions and surface condition, for a given fluid, but also markedly with the flow rate, and usually, in turbulent flow, with flow rate modified by some exponent with value on the order of 2.0. The concept of flow "resistance," to represent opposition to fluid flow, is a useful tool. The pressure drop in any process branch line may be considered as proportional to the product of the flow rate and the pipeline resistance, and for turbulent flow the resistance itself may be considered a function of the flow rate. Thus, the flow characteristics of a network may be simulated by electrical analogy, with the electrical resistance in each branch simultaneously adjusted to some desired function of the electrical current. Voltage and current determinations at given points are representative of the corresponding fluid pressure and flow rates. An illustrative process-plant network with numerous branches and discharge points is analyzed, with predictions of flow distributions and pressures.

Air Pollution

CO Boiler Pays Off in Fuel Savings and Produces Zero CO, by N. E. Pennels, Sinclair Refining Company, East Chicago, Ind. 1956 ASME Annual Meeting paper No. 56—A-198 (multilithographed; available to Oct. 1, 1957).

THE CO Boiler was developed to effect substantial fuel savings through the combustion of the carbon monoxide content of catalytic cracking unit regenerator flue gases. The ability of the CO Boiler to burn the regenerator flue gas to zero carbon monoxide makes the CO Boiler an effective air-pollution control device in areas where local conditions require limitations on emission of carbon monoxide to the atmosphere. This paper is concerned with the application of CO Boilers to the Fluid Cracking Process units.

Operation of the first CO Boiler at the Sinclair Refining Company's Houston Refinery has been successful, resulting in complete combustion of CO to CO_2 and effecting substantial fuel savings. On this unit approximately 180 million Btu/hr are recovered from the sensible heat of the carbon-monoxide gas, and 140 million Btu/hr from the combustion of the carbon-monoxide for a total waste heat recovery of 320 million Btu/hr.

Experimental Investigation of Critical Design Factors for Vane-Type Cyclone Collectors, by A. B. Walker and W. H. Cole, Research-Cottrell, Inc., Bound Brook, N. J. 1956 ASME Annual Meeting paper 56—A-199 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1957).

MOST of the so-called high efficiency mechanical dust collecting cyclones in use today are of the multiple-tube vane type. A basic investigation has been made on the effects of tube size, inlet vane design, and utilization of outlet tube vanes on the performance of this type collector. The critical nature of these factors and methods for obtaining higher efficiency and gas flow are demonstrated in this paper. Initial studies indicate the possibilities for increase of cyclone collector efficiencies by means other than the customary reduction of the collector tube diameter. A comparison between predicted field results from laboratory tests and actual field results is presented, and the accuracy of specific laboratory techniques in predicting field performance is indicated.

Metals Engineering

The Back Extrusion of Heavy-Walled Zircaloy-2 Cups, by J. G. Goodwin and R. W. Tombaugh, Mem. ASME, Westinghouse Corporation, Pittsburgh, Pa. 1957 ASME Spring Meeting paper No. 57—S-15 (multilithographed; available to Feb. 1, 1958).

MATERIALS development at the Westinghouse Atomic Power Division required quantities of heavy-walled Zircaloy-2 components. Zircaloy-2 is a zirconium-base alloy with nominal composition of 1.45 per cent tin, 0.12 per cent iron, 0.10 per cent chromium, and 0.05 per cent nickel. Several methods for the manufacture of this item included machining from solid bar, back extrusion, and direct extrusion. Because Zircaloy-2 bar stock costs approximately $25 per pound, and because remelted machine scrap is not usable in nuclear reactors as its corrosion resistance is lowered considerably due to contamination, machining any quantity of these components was not considered. Contamination with carbon during the melting of machine scrap is caused by the residual cutting fluids which are difficult to remove with ordinary cleaning procedures; contamination with oxygen during the melting of machine scrap is due to the thin layer of oxide formed over each chip from the reaction of the Zircaloy-2 (heated from the machining operation) with air. Attemps at removing these contaminating agents have had only limited success. Carbon lowers the hot-water corrosion resistance of the Zircaloy-2, and oxygen reduces the ductility. Back extrusion was selected as the method for producing this item because it (*a*) produced a product near to the shape of the finished item, (*b*) required only a minor amount of machining to produce the finished item, (*c*) permitted fast deliveries, and (*d*) was suitable for producing small quantities at a time.

This paper describes the development of methods for the back extrusion of heavy-walled Zircaloy-2 cups. The use of vertical and horizontal presses is dis-

cussed as is the use of various lubricants. Bar stock preparation, extrusion billet preparation, and billet heating are presented.

Chromium-Molybdenum and Chromium-Molybdenum Vanadium Steels for Power Plant and Refinery Service up to 1100 F, An appraisal of the literature, by G. V. Smith, Cornell University, Ithaca, N. Y. 1956 ASME Annual Meeting paper No. 56—A-214 (available to Oct. 1, 1957).

THE designer of power-plant and refinery equipment for service up to 1100 F wants the optimum combination of high-temperature strength and reliability possible on a commercial scale. Moreover, although he wants to increase working temperatures as much as possible, he prefers to use ferritic rather than austenitic steels. His choice for temperatures from about 900 to perhaps 1050 or 1100 F rests mainly between the 1–3 per cent chromium, $\frac{1}{2}$–1 per cent molybdenum steels, and the 1 per cent chromium, 1 per cent molybdenum, $\frac{1}{4}$ per cent vanadium type. The chromium-molybdenum-vanadium type offers the enticing prospect of higher allowable stresses and of usable strengths at temperatures up to 1100 F and perhaps higher. In an attempt to give the designer the facts for making a decision on which type steel to use, the many articles in the literature have been surveyed.

ASME Transactions

THE May, 1957, issue of the Transactions of the ASME (available at $1 per copy to members; $1.50 to nonmembers), contains the following technical papers:

Strength Characteristics of Rock Samples Under Hydrostatic Pressure, by R. O. Bredthauer. (56—PET-23)

Prevention of Destructive Engine Failure by Spectrographic Analysis of Crankcase Oils, by R. E. Linnard, C. B. Threlkeld, and R. T. Blades. (56—PET-30)

Materials Aspect of Some High-Temperature, Refinery-Piping Applications, by E. A. Sticha. (56—PET-21)

Operating Considerations in Application of Gas-Turbine-Driven, Centrifugal, Pipeline Compressors, by A. L. Vaughan. (56—PET-13)

The Unsteady Laminar Boundary Layer on a Flat Plate, by Sin-I Cheng and David Elliott

Ebullition From Solid Surfaces in the Absence of a Pre-Existing Gaseous Phase, by S. G. Bankoff

Natural-Convection Heat Transfer From a Horizontal Cylinder Rotating in Air, by David Dropkin and Arieh Carmi

Experimental Study of the Velocity and Temperature Distribution in a High-Velocity Vortex-Type Flow, by J. P. Hartnett and E. R. G. Eckert

Solving the Melting Problem Using the Electric Analogy to Heat Conduction, by D. R. Otis

Effect of Axial Fluid Conduction on Heat Transfer in the Entrance Regions of Parallel Plates and Tubes, by P. J. Schneider

On the Changing Size Spectrum of Particle Clouds Undergoing Evaporation, Combustion, or Acceleration, by A. H. Shapiro and A. J. Erickson

Heat Transfer in a Pipe With Turbulent Flow and Arbitrary Wall-Temperature Distribution, by C. A. Sleicher, Jr., and M. Tribus

Practical Equipment-Replacement Economics, by P. A. Scheuble, Jr. (56—MGT-2)

Applying Linear Programming to Inventory Planning in a Seasonal Market—A Case Study, by D. W. Moffett. (56—MGT-1)

A Combustion System for Spark-Fired Gas Engines Using Diesel Compression Ratios, by L. D. Thompson, R. H. Beadle, and F. A. Blake. (56—OGP-6)

The Application of an Analog Computer to the Measurement of Process Dynamics, by P. E. A. Cowley. (56—IRD-20)

Criteria for Validity of Lumped-Parameter Representation of Ducting Air-Flow Characteristics, by T. R. Stalzer and G. J. Fiedler. (56—IRD-21)

A Graphical Method for the Analysis of Piecewise Linear Control Systems, With Particular Application to Relay Controls, by R. H. Macmillan. (56—SA-17)

On the Dynamics of Pneumatic Transmission Lines, by C. P. Rohmann and E. C. Grogan. (56—SA-1)

Analysis and Design of a Servomotor Operating on High-Pressure Compressed Gas, by Gerhard Reethof. (56—SA-20)

Problems Encountered in the Translation of Compressor Performance From One Gas to Another, by M. J. Hartmann and W. W. Wilcox. (56—SA-61)

Heat-Transfer Rates to Crossflowing Mercury in a Staggered Tube Bank—I, by R. J. Hoe, D. Dropkin, and O. E. Dwyer. (56—SA-28)

Forces and Power Required to Turn Aluminum and Seven Alloys, by O. W. Boston and W. W. Gilbert. (56—SA-14)

Comparative Machinability of B1113—C1213—C1120 HR—C1120 CD and C1119 Steels, by H. L. Bryden. (56—SA-26)

Effect of Cold Work on Elevated-Temperature Properties of Types 301, 305, and 310 Stainless Steels, by R. A. Lula, A. J. Lena, and H. M. Johnson. (56—SA-44)

Avon No. 8—A Supercritical-Pressure Plant, by C. A. Dauber. (56—SA-69)

Effect of Internal Pressure on Flexibility and Stress-Intensification Factors of Curved Pipe or Welding Elbows, by E. C. Rodabaugh and H. H. George. (56—SA-50)

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

U. S. Industry

To the Editor:

Two papers recently published in Mechanical Engineering, one by W. A. Hadley[1] and the other by F. S. Blackall, jr.,[2] require some discussion.

From the two papers, which to a large extent compare the quality of U. S. and European automobiles, it is evident to the Europeans, who have read them, that the authors were insufficiently familiar with the European part of the story. To elucidate, the writer would like to make the following comments.

- The familiar slogan, "you get more automobile for your money in the American cars," is entirely misleading. This plainly is evident to engineers and technically trained men who know that the cost of any vehicle increases with decreasing weight. That is especially true for missiles and for aircraft as well as for European cars.
- The purchase price of a car is something quite different from the cost to operate a car. The explanation of the fact that the average American family spends the same amount on operating a car as they spend on food is that the U. S. automobile has built-in obsolescence, with extremely high depreciation cost as a result. Actually, Rolls-Royces and Cadillacs are among the cheapest cars in the world.
- It is to be regretted that stylists play such an important role in the U. S. automobile industry, but it is a consequence of mass-production. In the U. S. the design of the facilities to manufacture a car is far more important to the automobile manufacturers than the design of the car itself. Therefore, the U. S. car is quite stereotype as compared to the European. Just remember that today there is no American car with front-wheel drive, independent rear suspension, air-cooled engine, electric fuel pump, wet cylinder liners, rear engine, or engine with overhead camshaft.
- Following the example of one of the papers the writer comments on, here is a list of valuable properties all people on both sides of the Atlantic like and only some European cars really have:

Reliability: The Swedish Volvo, model PV 444, which is a low-priced medium-performance car, has a 5-year unconditional warranty with each new car sold in Sweden. Any repair over $70 is paid for by the Volvo Company, even to the second or following owner of the car.

Comfort: The automobile testers of the Consumers Union make the following statement in their January, 1957, report: "The Citroen has no peer among American cars, regardless of size, weight, or price, in the matter of passenger comfort." This car, the Citroen model DS 19, has a well-proved pneumatic-hydraulic suspension system and a wheelbase only 3 in. shorter than that of the U. S. Ford Motor Company's Continental, while the overhang of the DS 19 is 24 in. shorter than that of the Continental.

Design: The Citroen DS 19, which can be had at a moderate price off the showroom floor even in the northern part of Sweden, is generally considered to be 10 years ahead of any U. S. automobile today.

Style: The Italian Cisitalia, picked by the New York Museum of Modern Art for its 1951 exhibition on automobile styling, represents the all-time peak in good, sensible body style.

- It should be pointed out that both the European Fords and GM Vauxhalls and Opels have the same unit chassis and body construction as the Fiat, which one of the authors believes to be unsafe in case of a crash. An American automobile magazine, a couple of years ago, showed that both Ford and GM try out new designs on their European-made cars before introducing them into their U. S. models.
- It is most interesting to note that American trucks are built very much like European high-performance cars and also that they are priced accordingly. Their frames, steering mechanisms, suspension systems, tires, and brakes are designed and built for the truck drivers and for the fleet-owners, who know the valuable properties of a good vehicle.
- To the writer, the most important difference between U. S. and European cars is that today the U. S. cars are on fun to have, while even the smallest, cheapest European cars have personality in their performance, maintenance, and appearance.
- As for good will, I would like to mention that in Sweden the good will toward the people of the U. S. is very great and continuously growing. I fear, however, that papers like the ones commented on, might reduce the good will of its European readers mostly because of the tendency of the authors toward oversimplification and generalization.

Jan Webjorn.[3]

Reply by F. S. Blackall, jr.[4]

I feel very apologetic after reading Jan Webjorn's critique, at least to the extent that it applies to my comments on the relative merits of U. S. and European automobile design. Certainly the last thing that I should want to do would be to "reduce the good will of European readers" toward the people of the U. S.

But we are engineers, and as such, we should be dedicated to an objective attitude toward expressions of opinion. While I do not have a copy of my paper before me, my recollection is that I said that I had found nothing in my observations of European automobiles which altered my opinion that U. S. cars offered the buyer more per dollar than their European counterpart.

This comment obviously was addressed to the American buyer and, as such, it is still my opinion; but I am quite prepared to admit that it is colored by what I believe the average American buyer wants in an automobile.

[1] "Why Is U. S. Industry Strong?" by W. A. Hadley, Mechanical Engineering, vol. 78, September, 1956, pp. 820–822.

[2] "Recent Technical and Economic Developments in Western Europe," by F. S. Blackall, jr., Mechanical Engineering, vol. 79, January, 1957, pp. 27–30.
(*See also* "Comments on Papers" in March, 1957, issue of Mechanical Engineering, vol. 79, pp. 294–295.)

[3] Design Engineer, Electrical Division, AB Hagglund and Soner, Gullänget, Sweden. Assoc. Mem. ASME.

[4] President and Treasurer, The Taft-Peirce Manufacturing Company, Woonsocket, R. I. Past-President and Fellow ASME.

If you want a car which will hold the road on a race track at speeds of 100 mph and up, buy, say, an Alfa Romeo. If fuel economy figures high on your list, try a baby Renault or Fiat, an Austin, or any one of a dozen other excellent little cars produced in England, France, Germany, Italy, and Scandinavia. In referring to them as "little," I do not mean to be patronizing, but the average American family man and woman simply have difficulty getting in and out of them. If style is of no consequence, the British Prefect, Hillman, or Morris, or the German Wolkswagen, for example, are adequate, relatively cheap, long lived, and efficient. If you want a "funeral car" type of limousine, which will last forever and hold two families plus all their baggage on the roof, including trunks, purchase a British Daimler—if you can afford it.

Personally, at the price, I'd prefer a yacht.

But if you are looking for comfort, adequate interior space for passengers and luggage, attractive styling, ease of operation, good road performance (on U. S. highways), and simple low-cost maintenance, at a price which is extremely reasonable relative to anything possessing remotely comparable features, then I think you must award the palm to the U. S. automobile builder. These qualities, and the related attributes of the American family car are, I submit, what the average American wants when he invests in an automobile, and I still think that he'll get more of what he wants for his buck here at home than he will abroad. This is natural enough, for the U. S. market for goods is perhaps the classic example of an economic mechanism which creates through the forces of demand precisely those things which the public wants.

But this is not to deny Europe the privilege of creating the kinds of automobiles which *it* wants, too. *De gustibus non est disputandum!*

A Practical Unit of Length

To the Editor:

All of us recognize the value of having a decimal type of monetary system. This is probably the only unit in this country that is not converted in daily use. The problem of units consumes huge amounts of time in the training of engineering students, the use of technical research data, and, to a lesser degree, the working of any routine technical problem. There are even several systems using metric units. (The metric prefix complicates problems involving exponentials.)

History has shown that the addition of new units merely adds to the problem. However, a unit that is easily related to several other units may become very useful. The unit advocated meets this requirement as well as being of a practical numerical magnitude for general usage.

The new unit, called a fint, will be four inches in length. This is equal to 1.016 decimeter so that it can be used easily by those familiar with the metric system. There are three fints in each foot. The yard (9.0 fints) can be easily replaced in the measure of land distance by so many ten fints. Each 5.0 pounds per square inch will equal 80.0 pounds per square fint instead of 720.0 pounds per square foot.

The most important part of this choice of a unit of length, is that it can be accepted by all the various groups. Since it can use the same division marks as the fractions of an inch, it can be put on all the new scales that are made. This unit can be accepted by the machine-tool industry (0.001 fint equal 4 mil) and those concerned with legal charts and documents. The 1.6 per cent error introduced by using the fint instead of the decimeter in a modified metric system can be neglected in many scientific problems. The fint and the decimeter can become the permanent international standards of length.

Roger S. Johnson.[5]

Correction

A correction has been received from Argonne National Laboratory, Lemont, Ill., for the article "Nuclear Engineering—Where Do We Stand?" by R. G. Folsom and H. A. Ohlgren which appeared in the March, 1957, issue of Mechanical Engineering. In Table 1 on page 226, the Experimental Breeder Reactor No. 2 is attributed to Oak Ridge National Laboratory. The reactor actually was developed by Argonne National Laboratory.

[5] Graduate student, University of California, Berkeley, Calif. Assoc. Mem. ASME.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Pumps—Selection and Application

Pump Selection and Application. By Tyler G. Hicks. McGraw-Hill Book Company, Inc., New York, N. Y., 1957. Cloth, 6 × 9 in., figs., tables, index, xiv and 422 pp., $8.50.

Reviewed by Irving Taylor[1]

Why is it that the very articles and portions of books that purport to cover pump *selection* so often slide over it, into vague generalities and conflicting guidances, concerning the broader subject of pump *application*? Is it that the problem of choice is too difficult—that among the many service-condition variables, there cannot be set down a few fairly definite rules for choosing the main type or class of pump? Is it perhaps that editors fear to offend some pump manufacturers by publishing selection-recommendations that could militate against them? Is there still too much disagreement as to which types really are best suited?

The author deserves credit for starting to distinguish selection from application as the title implies. He has divided the book into three parts: Pump Classes and Types (3 chapters), Pump Selection (7 chapters), Pump Application (14 chapters). Despite this favorable proportion and much useful information, the main problem just doesn't get covered adequately. Insufficient thought was given

[1] Head, Pump and Compressor Section, The Lummus Company, New York, N. Y. Mem. ASME.

to the table "Characteristics of Modern Pumps," to which the author refers engineers for choosing probable class and type, once they have arrived at the capacity, the total head, and nature of the liquid. This table designates some vital pressure and capacity ranges as "low to high," or "small to medium." Elsewhere, the effects of viscosity on centrifugal pumps are covered, but it is not made clear in the table or in the text that viscosity is one of the big keys to the selection of main type.

The author allows that exceptionally severe conditions may rule out one or another class right at the start. Yet, the reader in search of help on selection is not told just which of the classes are eliminated, say, by a particular condition of 8000 SSU viscosity at the pumping temperature. Later on, in telling what kinds of pumps and pump features are often used for certain applications, he frequently fails to tell why.

And there are quite a number of errors in the book, only a few of which are typographical.

Despite all this criticism, the book acts to fill a need, it contains some new material (particularly on piping systems) and brings together valuable pump lore to be found only separately scattered elsewhere, it contains a great many good illustrations including most all of the latest designs. As a whole, a valiant effort and fairly successful on pump application, less so on selection.

Technical Publishing

THE FIRST ONE HUNDRED AND FIFTY YEARS: A History of John Wiley and Sons, Incorporated, 1807–1957. John Wiley and Sons, Inc., New York, N. Y., 1957. Cloth, 7 × 10 in., illus., index, xxv and 242 pp., $7.50.

Reviewed by Ralph H. Phelps[2]

IN 1807, when Charles Wiley opened his bookstore and printing shop on Reade Street in New York, N. Y., our nation had been in existence for only 31 years. New York with its thriving harbor, numerous coffeehouses where many business transactions were carried out, its supper parties and theaters, was becoming increasingly well known as the industrial and cultural center of the U. S. During his years as a bookseller (1807–1826), when American literature was still in its infancy, Charles Wiley's main contribution was made in encouraging and publishing native authors, such as: Nathaniel Hawthorne, James Fenimore Cooper, and Edgar Allen Poe. John Wiley, his son, took over the firm after his death, and in partnership with George Palmer Putnam (1837–1848), built up a strong list of both American and English literary books, reasonably priced before the era of mass production.

After his separation from Putnam in 1848, John Wiley began to concentrate on the scientific and technical works for which the firm is so well known today. His younger son, Major William H. Wiley, joined his father and older brother in 1876, after ten years as an engineer, and the organization then became known by its present name, John Wiley and Sons. Major Wiley, a charter member of the ASME and its treasurer from 1884 to 1925, knew many of the famous engineers and educators whose works he published. He played a large part in bringing the firm into the front ranks of technical publishing. During this time, Wiley began to publish the condensed engineering pocket books which have evolved into the technical handbooks of today. Since 1907, when John Wiley and Sons was incorporated, with Major Wiley as its first corporation president, it has almost entirely ceased publication of general literature.

The diversity of the subject matter published by Wiley is obvious in this book, the chapters of which have been written by twenty-eight important Wiley authors and firm members. The book, well printed on fine paper, includes reproductions of title pages of some early Wiley books and photographs of members of the firm. In addition to a brief chapter on Wiley's early literary books, subjects covered include: Chemistry, physics, mathematics, statistics, geology, geography, and biology; all types of engineering—civil, chemical, electrical, mechanical, industrial, aeronautical, and agricultural; drawing and descriptive geometry; mining and metallurgy; forestry; architecture; home economics; and psychology. Naturally, titles of Wiley publications predominate, but other significant early titles are also included. The titles are a historical mirroring of the various phases of development of science and industry.

In mechanical engineering, for example, the first successful application of steam power to navigational purposes was demonstrated by Robert Fulton's Clermont in 1807, the date of the firm's beginning. When, in 1829, the railroad locomotive revolutionized land transportation, John Wiley was just starting his long career. Wiley classics on the steam engine were by Rankine, in 1859, and Thurston, 1891. In 1895 "The Mechanical Engineers Pocket-Book," by William Kent, appeared. Coexistent with, and succeeding these, an increasing stream of books covering the entire range of mechanical interests has come from the Wiley presses. From the simple beginnings to our mechanized world with its promises of the utilization of nuclear power, automation, synthetic foods, and interplanetary travel, Wiley has kept up with the tremendous changes in techniques and methods involved, in the books that it has published during the 150 years of its existence.

[2] Director, Engineering Societies Library, New York, N. Y.

Books Received in Library

ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS. Vol. 8. Edited by L. Marton. 1956, Academic Press Inc., Publishers, New York, N. Y. 562 p., 6 × 9¼ in., bound. $13. The present volume in this series contains extensive critical reviews covering the following subjects: molecular beam techniques and applications; field emission; mass spectroscopy; amplitude and time measurement in nuclear physics; pulse-amplitude analysis, electron guns and focusing for high-density electron beams; the electrical life of oxide-cathode receiving tube; viewing storage tubes, and magnetron mode transitions. References are listed at the end of each review.

ANALYSIS OF DEFORMATION. Vol. 3. Fluidity. By Keith Swainger. 1956, The Macmillan Company, New York, N. Y. 266 p., 5½ × 8¾ in., bound. $13. The first volume of this treatise formulated the theory of the analysis of deformation; the second volume dealt with applications and available experimental evidence. The present volume presents the author's analysis of the fluidity aspects of deformation and a critical examination of the classical approach to fluid mechanics. The main topics considered are viscous plane flow; three-dimensional viscous flow; stress-fluidity; and the influence of boundary conditions on flow. The mathematics needed to follow the theory are given in appendixes devoted to vector analysis and the mathematics of rigid body motion.

THE DIECASTING PROCESS. By H. K. Barton. 1956, The Macmillan Company, New York, N. Y. 223 p., 5⅞ × 9 in., bound. $5. A concise treatment of the scope and limitations of the process, production techniques, details of die construction, diecasting machines, machining and finishing castings, and methods of assembling products with diecast parts. Also dealt with are plant organization and layout and the design of parts for diecasting.

THE ECONOMICS OF SOVIET STEEL. By M. Gardner Clark. 1956, Harvard University Press, Cambridge, Mass., 400 p., 6⅛ × 9½ in., bound. $7.50. A four-part study, based almost entirely on Soviet sources, of the development of the Russian iron and steel industry from 1917 to the present. The four parts are concerned, respectively, with the growth of production and investment; the specialization and size of plants and equipment; factors affecting plant location; and productivity. A considerable amount of

statistical data is provided in appendixes, and a bibliography is included.

EINFLUSSFLÄCHEN FÜR KREUZWERKE. By H. Homberg and J. Weinmeister. Second Edition, 1956. Springer-Verlag, Berlin, Germany. 156 p., $7^1/_2 \times 10^7/_8$ in., bound. DM 43.50. Structural analysis of grillages with varying numbers of longitudinal members and cross beams. Extensive tables and diagrammatic representations illustrate the theoretical aspects and aid in practical design. The information is applicable to steel, reinforced concrete, prestressed concrete, and wooden beams and girders for buildings and bridges.

AN ENCYCLOPEDIA OF THE IRON AND STEEL INDUSTRY. Compiled by A. K. Osborne. 1956, Philosophical Library, Inc., New York, N. Y. 558 p., $6 \times 9^1/_2$ in., bound. $25. An alphabetical list of terms relating to materials, tools, instruments, plant, and processes, with definitions varying in length from a single phase to half a column. Some definitions are keyed to a 29-page list of references where more complete information may be found. Conversion tables, tables of weights and measures, data on properties of various steels, and a directory of associations are appended.

ENGINEERING MATHEMATICS. By Kenneth S. Miller. 1956, Rinehart and Company, Inc., New York, N. Y. 417 p., $6 \times 9^1/_4$ in., bound. $6.50. This text for the first year of graduate work in engineering deals with the following topics: determinants and matrixes; special subjects in integration such as the Gamma function, the error function, and Euler's constant; linear differential equations; Fourier series and integrals; the Laplace transform; network theory; and probability, with emphasis on functions of random variables. The main text is supplemented by appendixes dealing, at a somewhat higher mathematical level, with Borel sets, the Riemann-Stieltjes integral, and Fourier series and integrals.

FATIGUE IN AIRCRAFT STRUCTURES. (Conference Proceedings, Columbia University, January, 1956.) Edited by Alfred M. Freudenthal. 1956, Academic Press Inc., New York, N. Y. 456 p., $6 \times 9^1/_4$ in., bound. $12. These proceedings contain the full text of 19 papers presented by physicists, physical metallurgists, test engineers, and aircraft designers concerned with the problems of the effect of fatigue on aircraft performance and safety. The three principal aspects of the subject dealt with are the physical mechanism and the theories of fatigue; fatigue testing and the prediction of fatigue life and strength; and actual design for fatigue. Contributions to the discussion are given in edited form at the end of each paper.

AN INTRODUCTION TO CYBERNETICS. By W. Ross Ashby. 1956, John Wiley and Sons, New York, N. Y. 295 p., $5^1/_2 \times 8^3/_4$ in., bound. $6.50. The basic ideas of cybernetics are treated in this book without reference to electronics and using no mathematics beyond elementary algebra. Part 1, devoted to the principles of mechanism, deals with stability, feedback, coupling, and statistical methods for analyzing large and complex systems. Part 2 uses the methods devoted in the first part to show what information is and how it is coded. The third and last part discusses mechanism and information as they are used for regulation and control in biological systems and provides the foundations for a general theory of complex regulating systems.

KONSTRUKTIVE GRUNDZÜGE UND PRAKTISCHE ERFAHRUNGEN BEIM BAU UND BETRIEB VON STAHLWASSERBAUTEN. By F. Köhler. 1956, Springer-Verlag, Berlin, Germany. 135 p., $5^3/_4 \times 9^1/_8$ in., paper. DM 13.20. Design principles and practical information on the construction and operation of steel hydraulic structures, with particular attention to weir gates and lock gates. Mechanical details are shown for various types of such machinery, with illustrations of equipment of German manufacture.

LABORATORY ADMINISTRATION. By E. S. Hiscocks. 1956, St. Martin's Press, New York, N. Y. 392 p., $5^1/_2 \times 8^3/_4$ in., bound. $8. In this book, the Secretary of the National Physical Laboratory in Great Britain examines the requirements in the organization and management of research laboratories which will provide the conditions in which scientific work can be most productive. Concerned with both governmental and industrial laboratories employing more than 200 people, the book deals with the functions of the director and the staff, recruitment, salaries, finance, technical services, buildings, training for management, and other matters, related to the day-by-day running of a research establishment. Some data on costs are given.

VDI BERICHTE. Band 13. Energieerzeugung. Band 15. Luftverunreinigung. Band 16. Kraftfahrzeugtechnik. 1956, VDI-Verlag, Düsseldorf, Germany. 72 p., 72 p., 84 p., $8^1/_4 \times 11^5/_8$ in., paper. DM 11.40, DM 13.80, DM 13.20. Continuing the series of reports on special meetings of the Verein Deutscher Ingenieure, these three publications deal with the following topics:

Vol. 13. Eight papers on modern power production in public utilities and industry, covering efficiency, industrial turbines, large turbogenerators, district heating, and new installations.

Vol. 15. Nine papers on air pollution in connection with the cement industry, iron and steel industry, steam-power plants, chemical industry, street traffic, and effect on vegetation.

Vol. 16. Nine papers on automotive engineering: lightweight construction, brake-testing, steering forces, speed evaluation, multiaxle vehicles, etc.

VISCOUS FLOW THEORY. Vol. 1. Laminar Flow. By Shih-I Pai. 1956, D. Van Nostrand Company, Inc., Princeton, N. J. 384 p., $6 \times 9^1/_4$ in., bound. $7.75. A study of the theory of the fluid dynamics of viscous fluids intended for engineers and research workers. In the first part of the book, the physical properties of gases are briefly reviewed, the fundamental equations (Navier-Stokes) are derived, and exact solutions for such problems as laminar flow between parallel walls and shock-wave thickness are presented. Over half the book is devoted to boundary-layer theory: the relevant equations; exact and approximate solutions of two-dimensional boundary-layer equations of steady flow; axially symmetrical and three-dimensional boundary-layer flows; unsteady flows; and flows with suction and injection.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

ASME Boiler and Pressure Vessel Code

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting March 1, 1957, and approved by the Board on April 22, 1957.)

Annulment of Cases

The following Cases are annulled:

Case Nos.	*Reasons for Annulment*
1138	Lack of use
1120-2	Stress values are now incorporated in Tables P-7 and UCS-23

Case No. 1232

(Interpretation of Par. H-68)

Inquiry: May the provisions of the proposed Pars. H-68(f) and (g) as published in the February, 1957, issue of MECHANICAL ENGINEERING be followed for steel heating boilers constructed to the 1956 Edition of Section IV, Low-Pressure Heating Boilers?

Reply: It is the opinion of the Committee that these provisions of Par. H-68(f) and (g) may be used for such steel heating boilers as meeting the intent of the Code.

Case No. 1236

(Special Ruling)

Inquiry: Is it permissible to use forgings conforming to the requirements of Specification SA-336, for constructions conforming to Sections I and VIII, except for the following requirements?

(a) *Chemical Requirements*

	Per Cent
Carbon, max	0.27
Manganese	0.50-0.80
Phosphorus, max	0.04
Sulfur, max	0.05
Silicon	0.15-0.35
Chromium	0.25-0.45
Nickel	0.50-0.90
Molybdenum	0.55-0.70

(b) *Heat-Treatment*

Heat-treatment shall consist of normalizing and tempering at not less than 1150 F.

For section thicknesses over 3 in. nominal, heat treatment may consist of accelerated cooling from the proper temperature to obtain effects comparable to those developed by normalizing section thicknesses less than 3 in. nominal, followed by tempering at not less than 1150 F.

(c) *Mechanical Properties*

Tensile strength, psi, min	80,000
Yield strength, psi, min	50,000
Elongation in 2 in., min, per cent	*20

* For material over $3\frac{1}{2}$ in. in thickness, a deduction from the percentage of elongation in 2 in. specified of 0.5 per cent shall be made for each increase of $\frac{1}{2}$ in. of the specified thickness above $3\frac{1}{2}$ in. This deduction shall not exceed 3 per cent.

(d) *Inspection*

When accelerated cooling is employed, all surfaces of the part shall be inspected for injurious defects by magnetic particle or penetrant oil methods.

Reply: It is the opinion of the Committee that forgings conforming to the requirements outlined in the inquiry may be used for constructions conforming to Sections I and VIII with the following additional requirements:

(1) This material may be used for service temperatures not exceeding 650 F.

(2) The allowable stress to be used between −20 and 650 F shall be 20,000 psi.

(3) The qualification of the welding procedure and the welders shall conform to the requirements of Section IX. A separate welding procedure and performance qualification shall be made for this material.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code...

As NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Unfired Pressure Vessels, 1956

PAR. UCI-37 Revise to read as follows:

UCI-37 *Corners and Fillets* A liberal radius shall be provided at projecting edges and reentrant corners in accordance with good foundry practice. Abrupt changes in surface contour and in wall thickness at junctures shall be avoided. Fillets and transition sections between adjacent main pressure containment walls or integral attachments thereto, such as nozzles, lugs, supports, flanges, and bosses, shall have radii or the equivalent not less than one-half of the thickness of the thinner of the sections being joined. Basic design, grade of iron, and other factors entering into the production of castings may require increased filleting over the minimum specified in order to provide the desired soundness of material.

Correction

The Announcement in the April 1957 MECHANICAL ENGINEERING of the availability of "Definitions and Explanations of Terms Used in Vessel Design" stated incorrectly that they had been approved by the Boiler and Pressure Vessel Committee. The "Definitions" have been released for distribution to obtain comments only.

Welding Qualifications, 1956

Table Q-11.1 Add the following specification under P-10:

Material Specification	Psi Min Tensile	Type of Material
SA-268, TP-443	70,000	Stainless Steel Tubing (20 Cr-1 Cu-0.20 max C)
SA-268, TP-446	70,000	Stainless Steel Tubing (27 Cr-1.50 Mn-0.20 max C)
SA-268, TP-329	75,000	Stainless Steel Tubing (27 Cr-1.50 Mo-0.20 max C-2.5-5.0 Ni)

Add a footnote reference *a* after "P-Number 10" in Table Q-11.1, and add a footnote to read as follows:

a Materials listed in P-Number 10 require independent qualification of each material.

Table Q-11.2 Add the following F-Number grouping of welding rods:

Weld Metal Type from Table Q-11.3			Welding Rod Classification Number (ASME Filler Metal Spec No.)
Applicable SA-Spec	(A-No. Ref)	(P-No.Ref)	SA-371 Type ER
SA-371	A-4	P-5	F-7
SA-371	A-5	P-6	F-7
SA-371	A-6	P-7	F-7
SA-371	A-7	P-8	F-7
SA-371	A-8	P-8	F-7

In footnote 1, revise third sentence as follows: "F-Numbers 5, 6, and 7 require independent qualification."

Roundup

Of Current Engineering Events, News, and Comment

E. S. Newman, *News Editor*

Government Support Urged in Industry Standards for Goods and Services

- *Government—biggest purchaser*
- *Government—tech information*
- *Government—public protector*

UNCLE SAM is industry's No. 1 customer. For this reason, it is imperative that he participate in the making of national standards for goods and services which he buys, according to Roger E. Gay, director of cataloging, standardization, and inspection, U. S. Department of Defense.

Mr. Gay addressed a luncheon meeting, April 25, of industrial leaders representing the 118 national trade and technical societies, and 2300 companies which are members of the American Standards Association. The American Society of Mechanical Engineers was one of the founder bodies of ASA and carries a heavy responsibility as administrator of a large number of Sectional Committees.

The luncheon meeting was part of the three-day conference of the Member-Bodies of ASA, held April 24-26, at the Hotel Biltmore, New York, N. Y. The conference was devoted to a joint meeting of the 14 Standard Boards, a meeting of the Member-Bodies and associate members, and a regular meeting for transaction of Standards Council business.

Mr. Gay said: "There are three powerful reasons why the government should support and participate in the work of the American Standards Association—the only agency established on the national level to co-ordinate the needs of the Federal Government with those of industry, in so far as standardization is concerned.

- "Government is the nation's largest purchaser of goods and services. If national standards can be developed with its help which meet the government's needs, and at the same time meet the needs of private industry and commerce, then mass production based on such standards will assure a quality product at an optimum price.
- "The Government is in possession of much technical information which belongs to the public as well as to the government, and standards are a main channel through which it can be passed on for use by appropriate technical committees.
- "The government must play a key role as protector of the public interest and has a duty to take full part in the development of standards as a means of advancing the national economy."

The Defense Department's own effort to establish cataloging, standardization, inspection in one single system was begun only five years ago, Mr. Gay reported. The Federal cataloging program, in 1952, set out to give a single name, identification, and classification number for each item in the then existing 14 supply systems.

The system is complete and is the basis for the standardization program now being carried on with reference to the Defense Department inventory and buying activities.

H. Thomas Hallowell, Jr., president of the American Standards Association, and president, Standard Pressed Steel Company, Jenkintown, Pa., announced that a Federal Standard on performance of tubes used for x rays had just been approved by ASA, and is the first Federal Standard to become an American Standard.

Mr. Hallowell told the group that the government is "looking to us to take the lead in the development of national standards for its own use... We must all act together with the ultimate aim of rendering all the services that Government

H. Thomas Hallowell, Jr., *left,* president, American Standards Association, presents the first Federal Standard to be approved as an American Standard to Willis S. MacLeod, director, Standardization Division, General Services Administration. With them are Vice-Admiral George F. Hussey, Jr., USN (ret.), ASA managing director, and Roger E. Gay, director, Office of Cataloging, Standardization and Inspection, U. S. Department of Defense. Mr. Gay was guest speaker at the ASA owner-management meeting, April 25, the second of a three-day meeting held at the Hotel Biltmore, New York, N. Y. Mr. Gay is a former president of the ASA.

needs in the way of standards and specification."

He also urged the group, as "owners and stockholders," to take complete advantage of the organization's membership in the International Organization for Standardization (ISO).

International Standards

He said: "International standards are becoming increasingly important to our national economy and defense. With almost $20 billion of export and defense shipments each year, we can achieve tremendous savings by helping to create more international standards."

It is no coincidence, he explained, that the American industries now doing the largest export business are the ones that have helped develop the most advanced international standards. These are the electrical industry, the motion picture industry, and photographic industry.

American Standards Needed

The demand for American Standards, measured by sales to industry and government, has increased 200 per cent over the past ten years, Vice-Admiral George F. Hussey, Jr., USN (ret.), managing director of the ASA, told the group. As an example of this, Admiral Hussey cited February, 1950, which had a sale of 8800 American Standards versus February of this year with sales of more than 22,000 copies of American Standards.

The Association approved 314 American Standards last year as compared to 90 ten years ago.

Industrial Productivity

Industrial productivity faces the problem of catching up with scientific discoveries and technological progress, Arthur S. Johnson, chairman of the ASA Standards Council, stated.

"Industry has reached a plateau," he said. "It has suddenly found itself trailing the snowballing technological and scientific discoveries of this age. It is aware that automation and nuclear are no longer synonymous with miracle."

Mr. Johnson observed that those attending the sessions of this meeting knew that national standards were the answer to translating technological progress into production in the same way that standards have brought the automobile, radio, and electric power to the people for mass consumption.

Can Women Crash the Gate?

Engineering educators seek means of closing manpower gap by supplying womanpower

Although the widening fields of engineering are admitting more women to their ranks, the problems facing women in these essentially male occupations are extremely complex.

In secondary schools, girls often are discouraged from entering upon an engineering or scientific career by guidance counselors and teachers. Women who finally do reach the nation's schools of engineering have a difficult time, not because of lack of brain power, but because they are women. Industry still maintains strong prejudices in hiring women engineers.

These are some of the opinions expressed at the third conference in the Joint Program for Technical Education held April 28 through May 1, on "Education of Girls for Careers in Science and Engineering," sponsored by the Columbia University School of Engineering, at Arden House, Harriman, N. Y. The meeting, which was attended by more than 100 secondary school principals and guidance counselors, representatives of liberal arts colleges, and industry, is supported by the Hebrew Technical Institute.

Womanpower Studied

Delegates to the three-day conference heard Henry David of the National Manpower Council say:

"The results of the National Manpower Council's two-year study of women's employment underscores the rigidities in the structure of women's employment and the relative rapidity with which changes in that rigid structure can be brought about. But such changes are the result of many factors, and any attempt to pinpoint a single device for encouraging more young women to pursue an education which prepares them to work as scientists and engineers, is bound to be self-defeating."

Future Changes

"Future changes," he continued, "in employment opportunities, in utilization practices, in educational changes, in personal values, in common beliefs about women's abilities, and in still other factors, will be essential before the nation's pool of scientists and engineers are appreciably increased by drawing upon our resources of womanpower."

Dr. David suggested that greater use by industry could be made of the women in their middle or later years. "To find ways of utilizing the large number of college trained women who will want to return to work when their children are of school age, would go far to reduce the gap between the demand for and the supply of personnel for scientific and engineering functions."

Growing Numbers

A ray of light in the somewhat discouraging picture of women in engineering was introduced by Beatrice A. Hicks, Mem. ASME and past-president of the Society of Women Engineers. She pointed out that industry is scraping the bottom of the barrel of engineering manpower, while talented women are seldom considered for employment.

Miss Hicks, who is president of the Newark Controls Company of New Jersey, reported that "There are about 2000 women engineers actively employed today and about 200 women engineers are graduated each year. Up until 1941 only 10 women engineers a year were graduated, while the number increased to 100 a year in the following decade. The majority of the women engineers are employed in design and sales," she said, "but there are few in production." Miss Hicks suggested that one of the reasons that more women did not enter the field of engineering stemmed from the fact that so few guidance counselors and teachers were competent to counsel on engineering as a career for women.

Iron Curtain Is High

Two representatives of industry, John H. Nair of Thomas J. Lipton, Inc., and

Leonard B. Landall of Raytheon Manufacturing Company, agreed that, although there was no policy as such against hiring women engineers, research directors and company management found that the normal career interruptions of women, such as marriage and childbirth, often upset team research. Another of industry's fears is that it is uneconomic to spend money training a woman engineer within the company, only to have her leave to get married. According to Mr. Landall, "Tradition operates against women engineers. Outside interests handicap women engineers in advancement. They are unable to give their whole energies to their job."

Dr. Nair stated that "in industry women are normally restricted to lower echelons and have difficulty in getting top jobs. Women in industry," he added, "lack the poise and stability to cope with adverse conditions. It is difficult for them to withstand criticism. Men," he said, "do not like working for women. Then, of course, there is the problem of night and weekend work."

Are Careers Sex-Typed?

Dr. Margaret Mead, anthropologist of the American Museum of Natural History, attributed the difficulties of women in engineering largely to sex-typing of careers.

"Engineering," she said, "is recognized as a male occupation. Until we re-do our thinking about the profession, women will have a difficult time following engineering as a career. Youth has a false idea of the scientist and engineer. The idea of engineering in management has not been made plain to the younger generation. What is needed is a broader styling of the professions so that they can use brainpower, whether it be man or woman."

Although women might bring originality to a field like engineering, Dr. Mead said, "The bulk of medical doctors in Russia now are women and, as a result, the profession there is depressed. Since sex-typing lends prestige to an occupation, engineering and science might become diluted if there were more women in them."

Future Scientists Speak

The younger generation was given an opportunity at the conference to voice their opinions. Five national science scholarship winners told of the difficulties they had in entering upon science studies and pre-engineering studies in grammar and high school.

Mary E. Harman, a sophomore premedical student at Cornell, said that "proper guidance was needed for children in grammar as well as high school." We also need more aptitude and interest tests, not only for the boys, but for the girls, too, she added. "The kind of job opportunities there are in science should be made known to all students."

Merry A. Margolish of New Rochelle High School, who is going into medical research said, "Students who want to go in for science are frequently discouraged from doing so by their teachers." She also suggested that there ought to be real science taught in high school, rather than the ninth-grade magic shows that pass for science. She suggested that top-flight science teachers be rotated throughout a school so that every class would have the benefit of good science teaching, in the same way that music is taught.

Paula Mayer and Sandra Lee Michael of Erasmus Hall High School, agreed that girls in school were considered unimportant as far as science was concerned, and need to have more information for career decisions.

"Women," according to Kullikki Kay Sprenk of Forest Hills, N. Y., High School, "should not be considered special cases. We should be treated equally according to our capacities in the field."

Various Opinions

Other speakers at the conference were Samuel Shenberg of the New York City Board of Education, who discussed "The New York City High School Girls and Boys: a study of their contribution to our scientific manpower reserves." He pointed out that a fear of advanced mathematics and physics was prevalent among high-school girls preparing for college because of "poor" guidance from "most" guidance counselors. Mrs. Marguerite Zapoleon, Women's Bureau, U. S. Department of Labor, discussed the planning of a career in engineering and the sciences. Alva Mathews of the Columbia School of Engineering, gave a first-hand account of how she made her way through Columbia's engineering school. Dr. Anne Roe, Psychological Training Unit, Franklin D. Roosevelt Veterans Administration Hospital, discussed "Psychosocial Factors in Engineering and Physical Sciences for Women." Prof. Esther McD. Lloyd-Jones of Teachers College, Columbia, discussed "The Lags of the Ladies." Professor Lloyd-Jones called on the guidance counselors to consider women in terms of their "multiple role" and give "far-seeing" guidance, taking into account their changing vocational needs that vary at any age from 20 to 40, and their adaptability to both home and the science laboratory.

Proceedings of the conference will be published, thus establishing a ready source of information on the subject for use by secondary-school educators and guidance counselors.

Beatrice A. Hicks, *left photo,* Mem. ASME, reports to a large audience of secondary-school educators and guidance counselors attending the conference on Education of Girls for Careers in Science that there are 2000 women engineers actively employed today

Discussion group, *right photo,* reviews facts presented by various speakers at the four-day conference on "Education of Girls for Careers in Science and Engineering," held at Arden House, April 28–May 1, and cosponsored by Columbia University and Hebrew Technical Institute of New York

Novel Thermodynamics Course at Lehigh Reviewed at Year's End

THE College of Engineering at Lehigh University, with the support of the Fund for the Advancement of Education, engaged in an experiment on the presentation of a unified basic course in thermodynamics. The students enrolled in the single-semester introductory course were a mixed group of chemists, chemical engineers, electrical engineers, engineering physicists, mechanical engineers, and metallurgical engineers.

A distinguished group of thermodynamicists from the fields of education and industry met at Lehigh University, Bethlehem, Pa., on April 29 and 30, 1957, at the invitation of Dean Loyal V. Bewley, to hear a report on the course content and the reaction of the teaching staff and students. At the conclusion of the report, the visiting group served as a panel to present their personal comments on the unified Lehigh course, as well as their opinions regarding the present scope of thermodynamics and its integration in the various undergraduate engineering curriculums.

A portion of the sessions was devoted to a discussion by Newman A. Hall, Mem. ASME, chairman of the department of mechanical engineering at Yale University, of the forthcoming report on "Thermodynamics, An Engineering Science," prepared by the ASEE ad hoc Committee on Thermodynamics. This presentation was pertinent to the general theme of the conference since it was the committee's objective, "to list the common core of thermodynamics information and to emphasize those features of the material which should be stressed in any good presentation of the subject."

The members of the panel included representatives from the fields of chemical engineering, chemistry, mechanical engineering, and physics, two of whom were from industry and the others from universities. The panel members included the following: James A. Beattie, M.I.T.; H. B. Callen, University of Pennsylvania; L. N. Canjar, Carnegie Institute of Technology; B. F. Dodge, Yale University; Newman A. Hall, Mem. ASME, Yale University; Joseph H. Keenan, Mem. ASME, M.I.T.; J. Kestin, Mem. ASME, and a technical editor of *Journal of Applied Mechanics*, Brown University; Hans Kraft, General Electric Company, Schenectady, N. Y.; John F. Lee, Assoc. Mem. ASME, North Carolina State College; John Marsh, Bethlehem Steel Corporation; and Mark Zemansky, New York City College.

Systems for Information Retrieval Symposium Merits Large Audience

THE Symposium on Systems for Information Retrieval, April 15-17, 1957, presented by the Western Reserve University School of Library Science, attracted a record number of 900 registrants to the three-day session.

The symposium was co-sponsored by more than 25 professional, industrial, and governmental organizations. Twenty five organizations prepared full-scale exhibits and gave demonstrations. The proceedings will be published during 1957 by Interscience Publishers, Inc., under the title "Information Systems in Documentations" (Advances in Documentation and Library Science, Vol. II).

Forty speakers and panelists participated in the regular technical sessions. The two banquets featured addresses by Verner W. Clapp, president, Council on Library Resources, and Robert C. Watson, Commissioner of Patents.

A closed-circuit television hookup between a demonstration area and the auditorium, enabled the audience to witness operating equipment and systems in co-ordination with the technical papers presented by the originators and operators of these systems.

The symposium served as a model technical information center. Its functioning was presented under the title, "Intercontinental Guided Missiles," by James Mack of Lehigh University. Scientific and technical questions originating with various organizations were received by teletype, telephone, and facsimile using the facilities of the Ohio Bell Telephone Company, The Bell Telephone Company of Pennsylvania, RCA Communications, Inc., American Telephone and Telegraph Company (Long Lines Department). Information in reply to incoming questions was provided either from files on exhibit at the conference or by long-distance consultation of exhibitors' files at their home offices. Requested information was furnished to inquirers over the same communication facilities as used for receiving inquiries.

The presentation of the Patent Office featured transmission of several questions to the SEAC computer at the Bureau of Standards in Washington, D. C., operation of the computer while its functions were being described to the audience, and receipt of the results of the searches which were in the field of steroid chemistry.

An additional feature of the program was a "live" phone interview before the audience between Bernard Benson of Benson, Lehner Company in Cleveland, Ohio, and the director of the French Information Service "S'il Vous Plait" in Paris, France. The service was explained to the audience by means of an amplified phone hookup.

An extracurricular evening meeting was conducted by "alumni" of the WRU seminar program and their guests at the Fenway Hall Hotel. The main topic for discussion was "The Specifications for an Information Searching Machine."

IMechE Meetings

July 12, 1957
Thermodynamic and Transport Properties of Fluids, 27 papers, IMechE, London

Oct. 1-3, 1957
Lubrication and Wear, 150 papers IMechE, London

February, 1958
Technology of Engineering Manufacture, 60 papers, IMechE, London

Autumn, 1958
International Conference on Gearing

Note: The foregoing calendar of The Institution of Mechanical Engineers' (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (IMechE) which is on file in the Engineering Societies Library, 29 West 39 St., New York, N. Y., and other libraries throughout the United States and Canada.

People

Honors and Awards. SIR JOHN DOUGLAS COCKCROFT, Director of Atomic Research in the United Kingdom, was recently the recipient of the Kelvin Medal. He received world fame for his work, along with Prof. E. T. S. Walton, in breaking the atomic nucleus by artificial means. They were awarded the Nobel Prize for Physics in 1951. From 1952 to 1954 Sir John served as Chairman of the Scientific Advisory Committee of the Ministry of Defence.

WALKER LEE CISLER, Fellow ASME, and president, The Detroit Edison Company, Detroit, Mich., was the recipient of the Washington Award for 1957. The award was presented by the Western Society of Engineers for "outstanding and untiring service to his country and mankind by making the world a better place to live through electric power."

The American Society of Lubrication Engineers has bestowed awards on three outstanding engineers for their contributions to the science of lubrication during the past year.

DUDLEY D. FULLER, Mem. ASME, professor of mechanical engineering, Columbia University, and principal scientist at The Franklin Institute of the State of Pennsylvania, received the ASLE National Award, which constitutes life membership in the ASLE, for his conspicuous service to the science of lubrication through research, educational leadership, and contributions to the literature.

DOUGLAS GODFREY, California Research Institute, was awarded the Captain Alfred E. Hunt Memorial Medal for his paper, "A Study of Fretting Wear in Mineral Oil." The award is presented for the best paper delivered before the ASLE by a member, or published in its journal, *Lubrication Engineering*, during the year.

ERNEST RABINOWICZ, research engineer, The Massachusetts Institute of Technology, was presented the Walter D. Hodson certificate and cash award, given for the best paper presented by an ASLE member 30 years of age or less. Dr. Rabinowicz received the award for his paper, "The Equilibrium Distribution of Transfer Fragments."

LOUIS B. NEWMAN, Mem. ASME, and chief of physical medicine and rehabilitation at the Veterans Administration Research Hospital, Chicago, Ill., has been named to receive the Alumni Distinguished Service Award at Illinois Institute of Technology. The award to Dr. Newman is in recognition of his services to the fields of science and medicine.

The American Welding Society at its Adams national meeting in Philadelphia, Pa., honored twenty-three individuals with five national and 18 regional awards.

The national awards were presented to: FRED L. PLUMMER, Mem. ASME, and director of engineering, Hammond Iron Works, Warren, Pa., who was named winner of the Samuel Wylie Miller Memorial Award; DEWITT C. SMITH, chief metallurgist, Harnischfeger Corporation, Milwaukee, Wis., who was presented with a certificate and honorarium upon the presentation of this year's Adams Lecture. O. B. J. FRASER, Mem. ASME, and assistant manager, International Nickel Company, New York, recipient of honorary membership in the Society; JAY BLAND, project engineer, Standard Oil Company, Indiana, Whiting, Ind., the 1957 Lincoln Gold Medalist; and A. N. KUGLER, Mem. ASME, chief welding engineer, Air Reduction Sales Company, New York, N. Y., who received the National Meritorious Service Award.

S. Logan Kerr, Fellow ASME, and consulting engineer, Flourtown, Pa., has been awarded honorary membership in the American Water Works Association. His citation described him as "one who is internationally recognized for his superior competence in the field of hydromechanics, ever willing to serve in widening the general understanding of difficult hydraulic problems."

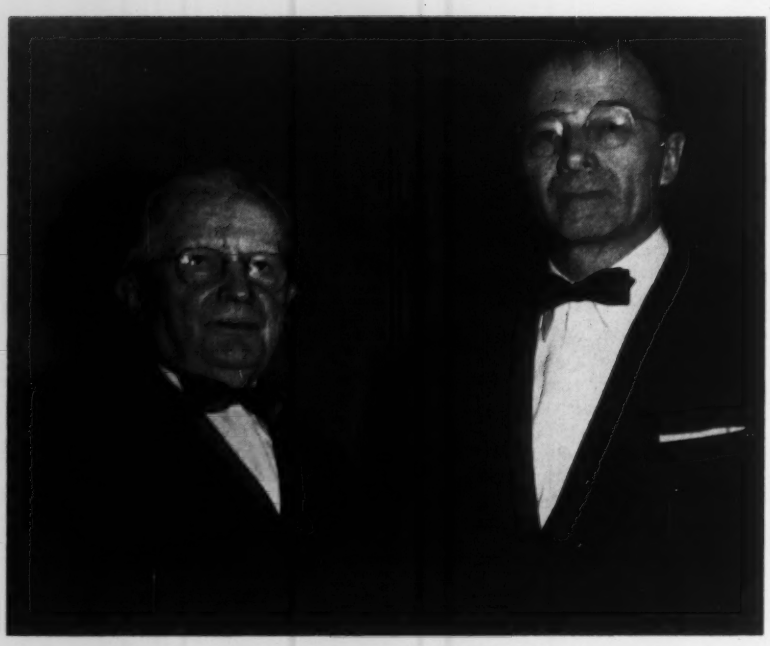
Paul V. Miller, *above*, Fellow ASME, and manager of the Taft-Peirce Small Tool Division, and Spencer Terry, Mem. ASME, were delegates to the convention of the International Organization for Standardization (ISO), held in Lisbon, Portugal, May 2–4. They served on ISO Technical Committee No. 1 to present the Unified Screw Thread System for adoption by other countries as a world standard.

Fellow Awards have been won by EUGENE MITTELMAN, consulting engineer, and RINALDO DE COLA, director of engineering, Admiral Corporation. The awards were presented at a banquet given in their honor by the Chicago Section of the Institute of Radio Engineers.

Retirements. EZRA J. KENNEDY, JR., assistant secretary of the American Institute of Mining, Metallurgical, and Petroleum Engineers, who served on the headquarters staff in New York for 31 years, has retired. Mr. Kennedy was editor of AIME Transactions and secretary of the technical publications committee.

BJARNE BASSÖE has retired from his office as secretary general of the Norwegian Engineering Society. ARNE NAGELL, who has functioned in this post since March 1, 1957, has been appointed his successor. Mr. Bassöe will retain his contact with the Society as adviser in educational matters.

Appointments. EUGENE R. BLACK, president, International Bank for Reconstruction and Development, Washington, D. C., announced the appointment of GAIL A. HATHAWAY, internationally



ASME President W. F. Ryan, *left*, chats with W. Paul Eddy, SAE President, at the Aircraft Propulsion Luncheon of the SAE National Aeronautic Meeting at the Commodore Hotel, New York, N. Y. The high light of the event was the presentation of the Daniel S. Guggenheim Award posthumously to F. B. Rentschler. The award was accepted by Mr. Rentschler's daughters, Mrs. N. P. Patch and Mrs. A. B. Rentschler. Mr. Eddy is chief of engineering operations at Pratt & Whitney Aircraft, East Hartford, Conn.

known civil engineer, as an engineering consultant in the Department of Technical Operations of the World Bank.

WILLIAM G. VAN NOTE, Mem. ASME, and president of Clarkson College of Technology, Potsdam, N. Y., has been appointed chairman of the commission on nontax supported colleges and universities of the State of New York. The commission was established to study the responsibilities and problems of private higher education in meeting the expanding school population of the state. The appointment was made by the Association of Colleges and Universities of the State of New York.

FREDERICK S. BURRELL, Assoc. Mem. ASME, has been appointed chief of the engineering-mechanics section of the mechanical-engineering division of The Franklin Institute Laboratories for Research and Development, Philadelphia, Pa. Under Mr. Burrell's guidance, the Section will expand the services it offers in the field of experimental and theoretical analyses of machinery, components, and structures to assist smaller industries, particularly in the Delaware Valley Area.

LESLIE F. ZSUFFA, Mem. ASME, has been appointed chief engineering adviser for the Southeastern regional office of the Small Business Administration. Mr. Zsuffa leaves the Georgia Institute of Technology to accept this government position, having organized and headed Georgia Tech's public relations department for the past 12 years.

Campus Data. CARROLL V. NEWSOM has been installed as the tenth president of New York University. The new president received the university's seal and original charter to symbolize the assumption of the office. Dr. Newsom, who assumed the duties of the presidency in October, 1956, succeeded HENRY T. HEALD, Mem. ASME, who became president of the Ford Foundation.

HAROLD TORGERSON, associate dean of the College of Engineering, New York University, has been appointed dean of the School of Engineering at the University of Connecticut, Storrs, Conn. He will supervise the departments of mechanical, electrical, civil, and mechanical-industrial engineering, and will direct development of new departments in chemical and aeronautical engineering.

MICHAEL G. MCGRAW, Mem. ASME, has been named director of the School of Electrical Engineering, International Correspondence Schools, Scranton, Pa. The appointment became effective April 22.

As a civilian engineer with the Navy Department from 1945 to 1952, he served successively as an engineering draftsman at the Naval Gun Factory, Washington, D. C.; as head of the Design Drafting Section, Aircraft Fire Control Division at the Naval Ordnance Test Station, Inyokern, California; and as a project engineer and head of the Mechanical Power Transmission Engineering Section at the U.S. Engineering Experiment Station, Annapolis. Assigned to the Bureau of Ships, Washington, Mr. McGraw did liaison work between the Bureau and the Navy Field Stations throughout the country. He is the author of numerous technical reports for the U. S. Navy.

Mr. McGraw joined the I.C.S. School of Mechanical Engineering in November, 1953. In July, 1954, he was appointed Assistant Director of the Mechanical Engineering School. A member of the University of Scranton Evening School Faculty, he is also a member of The American Society of Mechanical Engineers (ASME), the Instrument Society of America (ISA), and the Scranton Junior Chamber of Commerce.

I.C.S.'s new Electrical Engineering School Director resides at 2229 Boulevard Avenue, Scranton, with his wife, the former Vivian Martin of Annapolis, and their four sons and a daughter.

The Engineering Council of the Manhattan College School of Engineering has formed a third consultors' group. The consultors on administrative engineering, the third constituent unit fully formed within the Council established to help the School of Engineering plan its future program, are: BRADFORD N. CLARK, partner in Eggers and Higgins, Architects; KEMP W. REECE, Ebasco Services, Inc.; HENRY B. SARGENT, American and Foreign Power Company; and TIMOTHY E. SHEA, Western Electric Company.

New Officers. The American Welding Society elected its officers for the 1957-1958 fiscal year at its Adams national meeting, in Philadelphia, Pa. New president of the Society is CLARENCE P. SANDER, Los Angeles, Calif., United States Steel Corporation. He previously served as first vice-president of the Society. Other new officers are: first vice-president, GUSTAV O. HOGLUND, Mem. ASME, Alcoa Process Development Laboratory, New Kensington, Pa.; second vice-president, CHARLES I. MACGUFFIE, General Electric Company, York, Pa.; and treasurer, HARRY E. ROCKEFELLER, Mem. ASME, Linde Air Products Company, New York, N. Y.

The American Society of Lubrication

Engineers has announced the election of A. B. Two, Ford Motor Company, and B. T. Harding, Midwest Oil Company, to the Board of Directors of the Society. Directors hold office for three years. L. O. Witzenburg, Farval Corporation and The Cleveland Worm & Gear Company, was elected industrial director for a term of two years. For the 1957–1958 year, the following officers of the Society have been elected by the Board of Directors: president, J. O. McLean, Mem. ASME, Reynolds Metals Company; vice-president-at-large, J. D. Lykins, Wheeling Steel Corporation; secretary, J. L. Finkelmann, Chrysler Corporation; treasurer, J. W. Peterson, Standard Oil Company, Indiana.

Research. T. Paul Torda, Mem. ASME, and professor of engineering, Polytechnic Institute of Brooklyn, New York, N. Y., is beginning a project for an investigation of combustion instability and "scaling-up" of rocket motors. The work is being sponsored by a contract with the U. S. Air Force, Office of Scientific Research.

Education. Patricia Shafley, James W. Sneddon, and Kay Jack were the first three students in the nation to complete a two-year engineering secretarial course. The course, said to be the only one of its kind in the nation, was instituted in 1955 by the Business Training College in Pittsburgh, Pa.

William L. Batt, past-president and Hon. Mem. ASME, and former president of S.K.F. Industries, has been elected a trustee of the Foundation for Research on Human Behavior. The Foundation is a national nonprofit organization which supports behavioral research and promotes its use in the management of organizations. It makes grants to universities and other organizations for research on leadership, organization and management, public communication, and economic behavior.

Coming Meetings

Combustion Engine Congress

The Fourth International Congress on Combustion Engines (CIMAC) will be held June 17–25 in Zurich, Switzerland. Theme of the Congress will be "Pressure Charged Diesel Engines and Gas Turbines in Their Different Classes—Marine, Traction, and Large-Size Generating Equipment." ASME, through the Oil and Gas Power and Gas Turbine Power Divisions, now is participating in CIMAC.

Human Engineering

During the week of June 17, Dunlap and Associates, Inc., will present its Fifth Annual Human Engineering Institute at Stamford, Conn. The Institute will deal with design of equipment and systems to meet human requirements.

Detailed information about the five-day program may be obtained by writing Dunlap and Associates, Inc., 429 Atlantic Street, Stamford, Conn. Enrollment will be limited to permit devoting the appropriate amount of attention to each attendee's specific needs. The fee is $290.

Statistical Methods

The Technical Association of the Pulp and Paper Industry (TAPPI) is sponsoring its sixth annual course on the use of statistical methods in the paper industry, to be held on the campus of the University of Washington, Seattle, Wash., July 8–19. Cosponsors of the course will be the Technical Section of the Canadian Pulp and Paper Association and the Department of Chemical Engineering of the University of Washington.

British IRE

"Electronics in Automation" is the theme of The British Institution of Radio Engineers Convention to be held in the University of Cambridge, June 27–July 1.

Arrangements for the Convention have now been completed and thirty papers are being presented to cover six sessions: Office machinery and information processing; machine-tool control; chemical and other processes; simulators; automation in the electronics industry; and automatic measurement and inspection.

Further information may be obtained from the Institution's offices, 9 Bedford Square, London, W.C.1., England.

Engineering Education

The 65th annual meeting of the American Society for Engineering Education will be held June 17–21 at Cornell University, Ithaca, N. Y.

On their agenda will be most of the urgent problems facing engineering schools today—improving high-school science preparation, increasing the supply of engineering teachers for the rapidly growing enrollments, the problems of research and research manpower in engineering colleges, and more efficient use of colleges' limited facilities and staff.

Heat Transfer and Fluid Mechanics

The 1957 Heat Transfer and Fluid Mechanics Institute will be held June 19–21, at the California Institute of Technology in Pasadena, Calif.

The Institute is sponsored by five Western universities and several professional societies, including the ASME, and papers presenting technical and scientific advances in fluid mechanics, heat transfer, thermodynamics, and related fields will be read. Emphasis is given to topics covering more than one specific field which would not fall uniquely into one or more of the categories.

Creative Problem Solving

The University of Buffalo and the Creative Education Foundation will cosponsor the third annual Creative Problem-Solving Institute at the University of Buffalo, July 8–10.

Based on the textbook, "Applied Imagination," by Alex F. Osborn, president of the Foundation and vice-chairman of the board, Batten, Barton, Durstine and Osborn advertising agency, a major portion of the Institute will be devoted to "brainstorming" sessions.

Further information and reservations for the Institute may be obtained by writing to Dr. Sidney J. Parnes, University of Buffalo, Buffalo 14, N. Y.

Literature

Plumbing Code

The "National Plumbing Code Handbook: Standards and Design Information," based on National Plumbing Code ASA A40.8, and edited by Vincent T. Manas, Mem. ASME, consulting engineer, was recently published. Chapters relating to research and special technical material were prepared by Herbert N. Eaton, Mem. ASME, formerly Chief, Hydraulics Laboratory, National Bureau of Standards.

Plumbers and others concerned with the specifications, performance, and inspection of plumbing installations are offered a clear, simple guide to the National Plumbing Code in this new 544-page book. The handbook explains and illustrates the meaning and intent

of the Code, paragraph by paragraph, and includes related technical information and data to aid in the design and installation of plumbing, water supply, sewage, and drainage systems that will meet Code requirements.

The entire Code is covered in parts 1 and 2 of the book. Each paragraph of the Code is quoted and then explained in nontechnical language. Part 3 is devoted to technical studies and standards related to the principles of pneumatics and hydraulics embraced in a plumbing system.

The Code was designated as an American Standard by the American Standards Association in January, 1955. It has already been adopted as official by 30 states and numerous municipalities, and probably will serve as the basis of formulation for many local codes.

Published by McGraw-Hill Book Company, the $5^3/_8 \times 8$ illustrated book costs $7.50.

Engineers' Income

● "The Professional Income of Engineers—1956," an Engineers Joint Council Report, is said to be the most complete salary survey to date. The report on engineers' salary structure covers 107,000 engineering graduates, and relates earning to graduation year. Special tables are presented for engineers with graduate degrees. Tables show earning scales in 13 major employment areas. The 36-page booklet complete with graphs costs $1.50, and is available from the Engineers Joint Council, 29 W. 39th Street, New York 18, N. Y.

Atomic Energy

● "Radiation Safety and Major Activities in the Atomic Energy Programs, July-December 1956," the 21st Semi-Annual Report of the Atomic Energy Commission, describes the substantial expansion of the peaceful uses of atomic energy as well as the basic production of nuclear materials and the development of essential applications for defense purposes.

● Published by the U. S. Atomic Energy Commission, the 396-page, paper-bound book considers such subjects as raw materials, military and civilian applications of atomic energy, reactor development, and international activities. Aspects of radiation safety in atomic energy activities are discussed in relation to the Commission's role, safeguards for licensed activities, radioactive wastes, radiation protection in Commission activities, and related subjects. The book costs $1.25 and may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

● "Atomic Energy Applications With Reference to Underdeveloped Countries," a preliminary survey, by B. C. Netschert and S. H. Schurr, has been published by The Johns Hopkins Press, Baltimore 18, Md., for Resources for the Future. The range of applications of nuclear energy, the necessary conditions for its use, and international co-operation in nuclear energy research and development are discussed in this 144-page paper-bound book which costs $2.

Annual Reports

● The "24th Annual Report—Engineers' Council for Professional Development" presents the President's report, and the reports of its committees and the representatives of its constituent organizations. Also included is a list of institutions having accredited curriculums leading to first degrees in engineering in the United States. The 71-page report costs $1 and may be obtained from the Engineers' Council for Professional Development, 29 W. 39th Street, New York 18, N. Y.

● The "1956 Annual Report—Engineers Joint Council," the report of the President of EJC and its many committees, is now available. A copy of the EJC Constitution and By-Laws is also included. The 28-page report is obtainable upon request from the Engineers Joint Council, 29 W. 39th Street, New York 18, N. Y.

● The "Annual Report for 1956 of the National Bureau of Standards," published by the U. S. Department of Commerce, discusses the Bureau's research and development program; calibration, testing, and standard samples; and co-operative activities with other government agencies and industry. The 158-page, paper-bound book costs 60 cents and is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

● The "Forty-Second Annual Report of the National Advisory Committee for Aeronautics, 1956," describes the technical activities sponsored by the committee. Researches into boundary-layer control; high-speed flight; aerodynamics; and power plants for aircraft construction are among these activities. The booklet, 89 pages, costs 60 cents and may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Graphite for Atomic Reactors

"The Production and Properties of Graphite for Reactors" is the title of a new 61-page book available from National Carbon Company, a division of Union Carbide and Carbon Corporation. Written by L. M. Currie, V. C. Hamister, and H. G. MacPherson, the book is a complete printing of a paper presented at the United Nations International Conference on the Peaceful Uses of Atomic Energy at Geneva, Switzerland, August 8–20, 1955.

Detailed information is presented on the production of artificial graphite in the electric furnace, the effects of raw materials and processing variations, and three chapters are devoted to the physical, mechanical, and chemical properties. For a complimentary copy of "The Production and Properties of Graphite for Reactors," write on your company letterhead to National Carbon Company, 30 East 42nd Street, New York 17, N. Y.

Manpower

A study of the reasons why a severe shortage of scientists and engineers exists in the United States, and of the way we can best combat this crisis, is the major theme of a book published by New York University Press, "Engineering Enrollment in the United States," edited by Norman Barish and specialists in the various branches of engineering. The whole field of engineering education in this country is surveyed. The cost of the book is $7.50.

1957 Guide

The "Heating, Ventilating and Air-Conditioning Guide 1957," 35th Edition, published by the American Society of Heating and Air-Conditioning Engineers, is now available. The book contains many practical, technical, and design data.

The "Guide 1957" has an enlarged technical data section of more than 1250 pages, representing an increase of more than 70 pages to accommodate new and revised information. The Catalog Data Section also has been expanded, including reference material of 337 manufacturers.

Now available at $12 a copy, size 6×9, blue cloth bound, from the American Society of Heating and Air-Conditioning Engineers, 62 Worth Street, New York 13, N. Y.

Proceedings

"Analog Computers, Their Industrial Applications," proceedings of a symposium for management, April 10–11, 1956, has been published by Midwest Research Institute, Kansas City, Mo. The 210-page publication contains 13 technical papers among which are papers by Henry

M. Paynter, Mem. ASME; Robert B. Grant, Assoc. Mem. ASME; Rufus Oldenburger, Mem. ASME; L. J. Linde, Mem. ASME; and Samuel M. Zivi, Assoc. Mem. ASME.

The Proceedings, priced at $5, may be obtained from Midwest Research Institute, 425 Volker Blvd., Kansas City, Mo.

Industrial Films

Glass Industry

The availability of a 16-mm sound film, "Futures Unlimited," has been announced by L.O.F. Glass Fibers Company, Toledo, Ohio. This 26-min, full-color film describes the use of glass reinforcement in items ranging from aircraft to modern furniture.

A copy of the movie may be obtained by writing to Sales Promotion Department, L.O.F. Glass Fibers Company, 1810 Madison Avenue, Toledo 1, Ohio.

Work Sampling

"Introduction to Work Sampling," a 16-mm, sound, color and black and white film, will be of interest to industrial engineers, managers, supervisors, and students. The film shows how random sampling may be used for measuring work as well as delays and idle time. By means of a large panel containing 480 wood blocks representing the 480-min work day, the film explains and demonstrates how a random sample can be used to predict the whole.

Cost of rental of the film: color, $6; black and white, $3.50. Copies may be secured through the University of California Extension, Los Angeles 24, Calif.

Aluminum

"Unfinished Rainbows" is regarded as one of the top-ranking industrial films of all time. The 40-min motion picture in full color and sound offers a high-light history of the aluminum industry and of the Aluminum Company of America. Filmed in Hollywood, Calif., and Chicago, Ill., it stars Alan Ladd as Charles Martin Hall, the young scientist who invented the process which made possible abundant and low-cost production of aluminum.

It was Alcoa's first major effort in film production. Since that time, the company has made 20 other films. Some of these, such as "Curiosity Shop" and "This Is Aluminum," follow "Unfinished Rainbows" as educational and entertaining films for the general public. Others, such as "New Horizons in Aluminum Brazing" and "Welding Advances with Aluminum," deal with industrial techniques and processes.

Complete film information can be obtained by writing Motion Picture Section, Aluminum Company of America, 1501 Alcoa Building, Pittsburgh 19, Pa.

Modern Methods for Joining Metals

This new film shows a variety of welding processes and applications, and is treated in a generally nontechnical manner.

Filmed at leading metal-fabricating companies, and Linde Air Products Company's laboratories, this 28-min sound and color motion picture illustrates the importance of the welding engineer in industry. It also shows the many factors involved in electric welding and how research, development, and engineering serve to provide increasingly better methods and equipment.

Arrangements to see this picture can be made by writing to Linde Air Products Company, 30 East 42nd Street, New York 17, N. Y.

Motor Maintenance

Two 20-min, 35-mm, colored, sound-slide films which show maintenance people how to install and properly maintain electric motors are now available from Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

The films, "How to Make a Motor Go and Go, and Go, and Go," covering maintenance, and "How to Take Step Seven," dealing with proper installation, depict by means of cartoon characters and illustrations how motors can be kept in good operating condition.

A viewing of the films can be arranged by contacting Allis-Chalmers' nearest Industries Group sales office.

Meetings of Other Societies

June 16–21
American Society for Testing Materials, annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

June 17–21
American Society for Engineering Education, annual meeting, Cornell University, Ithaca, N. Y.

June 17–25
International Congress on Combustion Engines, Zurich, Switzerland

June 19–21
1957 Heat Transfer and Fluid Mechanics Institute, California Institute of Technology, Pasadena, Calif.

June 23–26
American Society of Agricultural Engineers, annual meeting, Michigan State University, East Lansing, Mich.

June 23–28
Forest Products Research Society, annual meeting, Hotel Statler, Buffalo, N. Y.

June 23–28
National Association of Power Engineers, Pantlind Hotel, Grand Rapids, Mich.

June 24–26
American Society of Heating and Air-Conditioning Engineers, semi-annual meeting, Manoir Richelieu, Murray Bay, Que., Canada

June 24–28
American Institute of Electrical Engineers, summer general meeting, Sheraton-Mount Royal Hotel, Montreal, Canada

June 25–27
Max Planck Society for the Advancement of Science, annual general assembly, Lubeck, Germany

July 1–6
Brazilian Society for the Advancement of Science, annual meeting, Rio de Janeiro, Brazil

July 10–20
British Plastics Exposition and Convention, Grand and National Halls, Olympia and London, England

(For ASME Coming Events, see page 616)

Photographers Take Notice!

At the ASME Semi-Annual Meeting in San Francisco, Calif., June 9-13, the Photographic Committee will help you get the most out of your trip. Be sure to contact them as soon as you register. In addition to having local information for your guidance, pictures will be shown of technical and scenic interest. Check your program for details.

ASME News

With Notes on Society Activities and Events

E. S. Newman, *News Editor*

Birmingham Section Plays Host to 1957 ASME Spring Meeting

More than 300 attend technical sessions, inspection tours, and social events

ENGINEERS, more than 300, from all parts of the country were on hand for the ASME Spring Meeting, which was held in co-operation with the Birmingham Section, April 7–10, 1957, at the Dinkler-Tutwiler Hotel in Birmingham, Ala. The three-day session included a host of technical papers, panel discussions, inspection trips, and an excellent women's program.

Dinner and luncheon speakers included Dr. William F. Ryan, President of The American Society of Mechanical Engineers, who spoke on the communications problem within engineering groups; Shelton Fisher, publisher of *Power* magazine, recently returned from a trip to Russia, who discussed "The Status of Russian Power Today"; and James L. Brakefield, director of public relations of the Liberty National Insurance Company, who addressed the banquet on the "Sixth Factor in American Business."

Besides the technical papers presented, panel sessions considered such problems as improving engineering education in the nation's schools and colleges, and encouraging "professional development" of engineers in order to increase the capacity of practicing engineers, thereby helping to alleviate the present shortage of skilled talent.

President's Luncheon

Professionally, the practitioners of engineering are an amorphous group, over-organized in some respects, but fundamentally completely unorganized, incapable of effective communication either within or without our ranks. So said ASME President W. F. Ryan, principal speaker at the President's Luncheon, opening social function of the 1957 Spring Meeting. We have more than 100 engineering societies, only a few of which restrict their membership to engineers. He pointed out that we form councils and federations, highly conceived, and engaging the unremitting labors of a few thousand men, in pursuit of an elusive goal we call professional unity. But, he added, while the Census Bureau says there are 650,000 engineers in the United States, we cannot find half that number who are contributing time, money, or even thought to their vocation as a profession.

Hence, Mr. Ryan continued, ASME, in co-operation with various other societies, proposes to have a survey of the engineering profession made under the joint auspices of Engineers Joint Council and Engineers' Council for Professional Development. The present status of the survey is that the several societies comprising EJC and ECPD have subscribed $50,000 for a preliminary study to determine the scope and objectives of a major survey and to develop to the best of our ability the profit, to our country and the world, that such a survey might produce. According to Mr. Ryan, critical problems have arisen in every facet of the profession—education, utilization of manpower, social and economic factors, all of which intimately concern the Nation's welfare.

The scope of the survey, Mr. Ryan indicated, would certainly attempt to answer the following questions: What is engineering? What is an engineer? What will be the demand for engineers in the future? What proportion of young Americans with the available mentality can be counted upon, since we must share the available talent with medicine

Shown *left* to *right* at the Power Luncheon are E. E. Williams, Shelton Fisher, principal speaker, and James M. Todd

and pure science as well as with other less scientific callings? Whether or not the shortage is really with respect to numbers or merely a result of misuse of the men who are prepared to handle our strictly engineering work? Other questions would deal with professional recognition, engineering education, teachers' compensation, social and humanistic instruction, and the like.

How the ultimate survey will be conducted and what it will cost are matters for further study. Mr. Ryan hopes that some beneficent foundation will finance the study since it will cost more money than our engineering societies could readily produce. One or more of our foundations could hardly make better use of their funds than by creating a true profession of engineering, Mr. Ryan concluded.

As part of the luncheon program, Birmingham's Mayor James M. Morgan welcomed ASME members, their wives, and guests to his city and presented the key to the city to Mr. Ryan.

James H. Sams, Mem. ASME, Vice-President of Region IV, dean of the School of Engineering, Clemson Agricultural College, Clemson, N. C., presided.

Power Luncheon

A glimpse inside Russia was given to attendees at the Power Luncheon on Tuesday by Shelton Fisher, Mem. ASME and publisher of *Power* magazine. Mr. Fisher, who toured the Soviet power industry last year, reported that since 1945, Russia has quadrupled its electric-generating capacity, placing it about where we were in 1927. The major portion of this energy, he pointed out, was being used by heavy industry. Mr. Fisher also revealed that, by 1960, the Russians expect to have installed about 2,500,000 kw of nuclear generating capacity. This is to be accomplished by eight units—each of different design.

About the country itself, Mr. Fisher noted that the roads he traveled were extremely poor, electric lighting was scarce, and in general, living conditions, from our standpoint, left much to be desired.

About the people, Mr. Fisher observed that his contacts were extremely friendly. They expressed a genuine interest in the United States—our cars, roads, educational system, sports, even juvenile delinquency. In fact, they seemed to be well informed about many of our developments.

Mr. Fisher expressed the hope that such visits or exchanges between the U. S. and Russia would result in better communications and thereby promote a better understanding and relationship between the countries.

E. E. Williams, Fellow ASME and vice-president of Duke Power Company, Charlotte, N. C., introduced Mr. Fisher. James M. Todd, past-president and Fellow ASME, owner, Design Engineers Associates of New Orleans, La., presided.

Banquet

With Stephen D. Moxley, Fellow ASME, and president of the American Cast Iron Pipe Company, acting as genial toastmaster, the banquet on Tuesday evening proved to be the high-light social event of the meeting. Mr. Moxley, in his inimitable southern style, deftly handled the dinner program which included the following:

Francis R. O'Brien, chairman of the Spring Meeting, called for recognition of the various committees that worked to make the meeting a success; and

Recognition of Fifty-Year members of ASME among whom were included: James A. Johnston, Oliver C. Spurling, A. F. Stillman, and C. B. Veal.

The principal speaker at the banquet, J. L. Brakefield, director of public relations of the Liberty National Life Insurance Company, held the attention of the audience with a humorous talk on American business and the American way of life.

Technical Program

The varied technical program of 11 sessions included 28 papers which covered subjects such as the latest techniques of administering plant maintenance, steam-station design characteristics as affected by fuel selection, techniques of drawing in the third dimension, application of product engineering to solid fuel rocket motors, more efficient production of industrial chemicals, and others.

Digests of the available papers presented at the meeting appear in the "ASME Technical Digest" section on pages 580 to 591 of this issue.

Inspection Trips

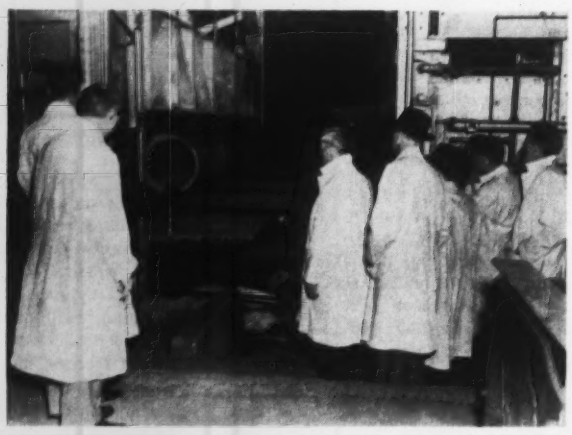
A feature of the meeting was the arranged inspection-trip agenda. It afforded a showcase for local industry and a gratifying view of engineering at work. The trips for this meeting were exceptionally attractive and more than 300 guests visited many or all of the points of interest. These included the following: Gorgas steam plant of the Alabama Power Company, American Cast Iron Pipe Company, Tennessee Coal and Iron Division of U. S. Steel Fairfield Works, Continental Gin Company, Hayes Aircraft Corporation, and an all-day trip to Redstone Arsenal at Huntsville, Ala.

The Gorgas plant, located on the

Mayor James Morgan of Birmingham presents key to city to ASME President W. F. Ryan at the President's Luncheon

Stephen D. Moxley holds forth as toastmaster during the ASME Spring Meeting Banquet

Warrior River, is of interest from several standpoints. The steam-power plant represents both the old and the new as far as steam-power production is concerned. Also viewed on this trip was the underground coal-gasification project being carried on by the Alabama Power Company and the Bureau of Mines.



Interested ASME'ers watch large-diameter pipe being annealed during American Cast Iron Pipe Company tour

ASME group shown during inspection trip through Alabama Power Company's Gorgas Steam Plant

Stewart Robertson Paul Dannenberg

Technical papers at the Spring Meeting covered a variety of technical subjects. Some of the authors included: Oswald Stewart, who gave a roundup of the latest techniques of administering plant maintenance; Lloyd P. Robertson, who discussed automated materials handling at General Electric's Appliance Park; Col. Thurston T. Paul, who presented the problems in supporting missile systems in the field; and Konrad K. Dannenberg, who outlined the difficulties encountered in the production engineering of large liquid-fuel rocket engines.

ACIPCo, a high-production pipe foundry, demonstrated the production of pressure pipe by the sand-lined mold process which was developed by ACIPCo engineers. The night operations were spectacular to see.

At the Tennessee Coal and Iron Division of U. S. Steel Fairfield Works, the complete manufacture of steel from the refining of finished steel was observed. On this tour, inspection included blast furnaces, open-hearth furnaces, blooming mills, hot-strip mills, plate mills, structural mills, merchant mills, and the cotton tie and hoop mills.

The Continental Gin Company showed the operation of a complete cotton gin equipped with the latest machinery. The manufacture of automation machinery also was seen.

Hayes Aircraft Corporation, established primarily as a modification center for the Air Force, has extended its activities to include the complete repair and overhaul of many types of military aircraft, and is engaged in the construction of refueling tankers. Here the complete operation was on view.

The concluding event was an all-day trip to the Redstone Arsenal at Huntsville, Ala., which made available an actual inspection of facilities at the Arsenal. In addition, those who attended were given a briefing on the Army Ballistic Missile Agency and the Ordnance Guided Missile School. The museum of the Arsenal was visited as well as rocket-test firing on the ballistic track and a display of the Nike and Corporal guided missiles.

Women's Program

After a get-acquainted party on Sunday evening, the wives of the members and guests of the Society had event-filled days to look forward to which included sightseeing, luncheons, and "inspection" of the local shopping situation.

The following day they had a difficult choice to make—either to attend the President's Luncheon or a Dutch Treat Luncheon at the Downtown Club of Birmingham. In the evening they were invited to join the men on a tour of the American Cast Iron Pipe Company—quite a number attended.

Tuesday was sight-seeing day. This trip, to explore the Vulcan Trail which highlights Birmingham and its environs, and a visit to historic Arlington, an ante bellum home, was followed by a luncheon at "The Club" high atop Red Mountain.

Wednesday was the day for the tour of Vestavia, the newest residential area of Birmingham, followed by a luncheon and show at the Vestavia Country Club.

General chairman for the women's program during the conference was Mrs. S. D. Moxley.

Committees

The chairmen of the various committees who so ably staged the meeting included: F. R. O'Brien, *General Arrangements;* J. Albert Keene, *Technical Events;* Kenneth R. Daniel, *Finance;* James W. Sloan, *Hotel;* Joseph W. Eshelman, *Reception;* Erskine Vandegrift, Jr., *Entertainment;* John Mummert, *Plant Trips;* A. H. Payne, *Printing and Signs;* George L. Bentley, *Information and Registration;* and John Little, *Publicity*.

Availability List—ASME Spring Meeting Papers

THE papers in this list are available in separate copy form until Jan. 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No. **Title and Author**

Fuels

57—S-13 Pulp-and-Paper-Mill Trends Toward Integrating Power and Bark-Burning Boilers, by L. P. COPIAN

57—S-14 Station-Design Considerations in Evaluating Selection of Fuels, by W. E. HOPKINS

Heat Transfer

57—S-2 Promotion of Dropwise Condensation of Several Pure Organic Vapors, by R. P. BABCO and A. L. GOSMAN

57—S-7 Free Convection From Heated-Surfaces—Laminar-Boundary Layers, by J. RUTKOWSKI

57—S-9 A Simplified Method for the Study of Two-Dimensional Transient Heat Flow Using Resistance Paper, by A. V. CLARK

Machine Design

57—S-1 Design of Warped Buckets for Optimum Efficiency, by W. H. WIEBE

57—S-3 Undercutting of Spur Gear Teeth, by G. H. MARTIN

57—S-5 Techniques of Drawing in the Third Dimension, by DAVID GORDON

57—S-6 Development of the Natco Feed-Rate Indicator, by R. A. SCHAFER and V. E. TICE

57—S-8 A Simple Formula for Determining the Position of Maximum Slider Velocity in a Slider-Crank Mechanism, by CHING-U IP and L. C. PRICE

Metals Engineering

57—S-15 The Back Extrusion of Heavy-Walled Zircaloy-2 Cups, by J. G. GOODWIN and R. W. TOMBAUGH

57—S-12 Component Fatigue Analysis for Maintenance, by R. J. LAUX

Power

57—S-10 A Practical Approach to the Allocation of Heat in an Industrial-Power Plant, by R. J. MARTIN

Production

57—S-4 Production Engineering of Solid-Fuel Rocket Motors, by E. C. ROBERTS, A. L. COUCH, JR., and R. D. WALKER

57—S-11 Production Engineering of Large Liquid-Fuel Rocket Engines, by K. K. DANNENBERG

A good look was taken at the engineering education picture during a panel session by these experts; *left* to *right* John H. Frye, Jr., John Gammell, N. W. Dougherty, James E. Johnson, and James R. Cudworth

ASME Handbook One of 1956 Best

AN ASME handbook, "Engineering Tables," has been selected as one of the 100 best technical books of 1956. The book, edited by Jesse Huckert, professor of mechanical engineering at The Ohio State University, provides a compact source of basic data on metals engineering. It was chosen on the basis of research conducted by Reginald R. Hawkins, chief of the Science and Technology Division of the New York Public Library.

The list of outstanding technical volumes, published to help librarians throughout the country to choose leading publications for their institutions, appears in the May 1 issue of *Library Journal*, published by McGraw-Hill Publishing Company.

The handbook was prepared to provide a collection of tables, up-to-date and generally recognized as standards which are often wanted by engineers engaged in mechanical design but which are not commonly found in handbooks. It is one of a series of four handbooks sponsored by the Metals Engineering Handbook Board of ASME. Companion volumes deal, respectively, with the design function, properties of metals, and processes by which metals are converted to finished products.

Priced at $12 each, copies of the Engineering Tables may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

ASME Instruments and Regulators Division Holds Annual Conference at Evanston, Illinois

ASME and AIChE, guests of Northwestern, meet in discussion of Control Analysis Techniques

At Evanston, Ill., in the scholarly atmosphere of Northwestern University, the Instruments and Regulators Division of The American Society of Mechanical Engineers held its third Annual Conference, April 7, 8, 9, and 10. The meeting, co-sponsored by the American Institute of Chemical Engineers, and the Process Industries Division of the ASME, and by the Chicago Section of the ASME, brought together 144 engineers and mathematicians whose effort is focused on the extremely exacting science of automatic controls.

Notable engineers present included Horald B. Gotaas, new dean of Northwestern's Technological Institute; Albert F. Sperry, Mem. ASME and president of Panellit, Inc.; J. H. Rushton, president of AIChE; and Rolland S. Stover, Vice-President of ASME Region VI. Chairman of the conference was Prof. Rufus Oldenburger, Mem. ASME, of Purdue University. Supporting him as General Chairman and co-chairman, were Donald J. Bergman for ASME, and David M. Boyd for AIChE, both members of the ASME and both of Universal Oil Products Company.

A New Science

Automatic regulation is a science which, in its present form, dates largely from World War II, brought into full being by the growing control problems of complex military apparatus. It is therefore not surprising that several of the papers presented in Evanston had a bearing on controls for military equipment—aircraft, guided missiles, gun-pointing systems, naval torpedoes. More than half of the papers sponsored by the ASME were excursions into pure mathematics, theoretical approaches to the solution of problems in automatic regulation.

The 19 papers were typified by the first one presented, when the conference convened Monday morning, in the big auditorium of the Technological Institute. Don Lebell of Ramo-Wooldridge Corporation and the University of California reported on the use of multiplier characteristics inherent in many power transducers, illustrating this for the case of an aircraft-type instrument servomechanism. He was followed by Rufus Oldenburger who tackled the problem of solving complex algebraic equations, a stumbling block in the mathematical approach to control design. Prof. Oldenburger explained procedures which enable him to approximate some of the roots, after which the solution for all of the roots can be obtained. The third and fourth papers were abstracted and presented in the absence of their authors. They were: "Analysis of the Transient Response of Nonlinear Control Systems," by P. E. W. Grensted, of the University of Cambridge, England; and "Statistical Treatment of Sampled-Data Control Systems for Actual Random Inputs," by Masahiro Mori, of the University of Tokyo.

The eighty men on hand for the Monday session lunched at the Sargent Hall cafeteria, with a stormy Lake Michigan foaming just beyond the picture windows. Like gas-turbine engineers, men engaged in this new science of automatic control are likely to be young. Many times in this meeting, the speaker was introduced as having won his bachelor degree since 1950, and his master's and doctorate as late as 1953. At lunch, speaking their special language of transfer functions, feedback, gain, zeros, and noise (not the noise of sound waves), these top-flight scientists were sometimes hard to distinguish from Northwestern undergraduates.

Marvin Shinbrot of the National Advisory Committee for Aeronautics opened the afternoon session, presenting a method for solving the integral equation which arises in optimization problems with nonstationary inputs. He illustrated the sort of problem that could be handled. J. H. Westcott, of London, England, was not on hand to read his paper, "Design of Multivariable Optimum Filters," and it was declared "read by title," and discussed by Dr. Oldenburger. R. E. Kalman of Columbia University then examined the problem of building a machine which adjusts itself automatically to control an arbitrary dynamic process, presenting in detail the design of a small computer which acts as such a machine.

Humor "corrupts the signal." Committeemen D. J. Bergman, R. E. Claridge, R. P. Sunderland, and D. M. Boyd get together in Sargent Hall.

The Social Swim

At the banquet, held that night in the Tip-Top Room, high in the Georgian Hotel, A. F. Sperry, a former president of the Instrument Society of America, made the introductions and established the easy-going atmosphere of the evening. Science relaxed. J. H. Rushton had looked up "instrumentation" and "regulation" in Webster's unabridged, and, on the basis of some of the definitions, viewed the whole business with mock alarm. Rolland S. Stover did a parody on the techniques of mathematician Oldenburger who, that morning, had demonstrated the solving of involved equations by throwing out difficult expressions which he foresaw would make no practical difference in the result, and changing awkward factors into convenient ones where insight told him the difference would be trifling. It looks so easy when Mr. Oldenburger does it. It was easy—and funny—when Mr. Stover did it at the banquet.

There came a serious interval when two awards were presented: to George A. Philbrick, Researchers, Inc., Boston, Mass., in recognition of contributions in the field of analog computation and its application to industrial process control; and to Wallace E. Belcher, Jr., Minneapolis-Honeywell Regulator Company, Philadelphia, Pa., for advancing the engineering profession in the field of instruments and regulators. Both men are members of the ASME.

The conference got back to mathematics, Tuesday morning, with four ASME papers, starting with C. C. Christianson of General Electric Company, who reported a dynamic-response study of a mechanical-hydraulic frequency-discriminator governor. Herman Thal-Larsen, Mem. ASME, of the University of California, spoke on correlation functions and noise patterns in control analysis. An analog study of a high-speed recording servomechanism was presented by J. W. Schwartzenberg of Leeds & Northrup. He showed that for various combinations of load friction and inertia, there is an optimum gear ratio that will give a minimum response time for a 100 per cent step change in input signal. E. F. Hochschild, Mem. ASME, of General Electric, wound up the morning session with his dynamic study of an experimental pneumatic process-pressure transmitter, a study of a highly accurate pressure-measuring device.

At the Monday evening banquet, in the Georgian's Tip-Top Room, A. F. Sperry, president of Panellit, Inc., welcomes the conferees and their wives to Evanston. Seated are, *left to right*, Rufus Oldenburger, chairman of IRD; A. J. Williams, Jr., Mem. ASME; J. H. Rushton, president of AIChE; R. S. Stover, vice-president, ASME, Region VI; and H. B. Gotaas, dean of Northwestern's Technological Institute.

After lunch-by-the-lake, the Chemical Institute took over, presenting three papers. T. J. Williams read a paper on automatic control in continuous distillation, controls to open and close valves for the chemical process in a fractioning tower. Otto J. M. Smith of the University of California spoke on servomechanisms and process controls that have transfer functions which include a pure transportation lag or flow time—called "dead time." He proposed a method to obtain high accuracy in such a system, using a minor feedback loop around the controller to prevent the dead-time-excited oscillations. The afternoon ended with a paper by R. Aris, University of Edinburgh, and N. R. Amundson, University of Minnesota, on the stability of some chemical systems under control.

Scientists at ease. *Left to right* are Otto J. M. Smith, University of California; Rufus Oldenburger, Purdue; and Kan Chen of Westinghouse.

Field Trips

On Thursday, the last day of the conference, ASME presented four papers, and there were trips to two near-by plants manufacturing equipment for instrumentation and regulation. Panellit, Inc., makers of graphic panels and data-accumulation and data-reduction units, served luncheon before taking a party through their plant, and there was a trip through the Powers Regulator Company, makers of controls for air-conditioning systems for large buildings and of industrial-process controls.

In the final session, on Thursday, the paper of Harold Adkins, of the Detroit Arsenal, was discussed in the absence of the author. He had written on "Practical Aspects of Relay or Pulse

Servomechanisms," with particular application to ordnance vehicles. T. E. Hoffman of M.I.T. presented a description of a force-input pneumatic amplifier designed and developed to fill the specific requirements of fast response, negligible hysteresis, linearity, and freedom from friction. The conference ended with two papers, both read by D. C. Union, Assoc. Mem. ASME, Shell Development Company, in which he described a field test on a steam turbine, obtaining data leading to the selection of control equipment; and a field test of a process furnace, using dynamic-response techniques to determine if automatic controls would increase profits.

Availability List—Instruments and Regulators Papers

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Paper No.	Title and Author
57—IRD-1	Multipliers for Nonlinear Compensation of Control Systems, by DON LEBELL
57—IRD-2	Algebraic Approach to Design of Automatic Controls, by RUFUS OLDENBURGER
57—IRD-3	Optimization of Time-Varying Linear Systems With Nonstationary Inputs, by MARVIN SHINBROT
57—IRD-4	A Linear, Force-Input, Pneumatic Amplifier With Fast Response Characteristics, by T. E. HOFFMAN

Quality in Textiles Goal of Conference Held by ASME at LTI

Textile quality aided by scientific developments in fiber uniformity

DEDICATED to "Quality," the 1957 Textile Engineering Conference spun a yarn of scientific developments and fiber-engineering methods which may solve yarn-uniformity problems and allow production of higher quality goods at lower costs.

The conference sponsored by the ASME Textile Engineering Division and the Boston Section in co-operation with The Lowell Technological Institute, Lowell, Mass., where the meeting was held on April 12, heard five speakers prominent in this field of engineering and had as principal speaker at the luncheon ASME President W. F. Ryan. The conferees were urged to prepare for and take advantage of an era when textiles will be a science in addition to being an art.

It was further stressed that these innovations should be employed at the earliest possible time if the industry is to lower its labor costs which are higher than any other industry when gross product is taken into consideration.

The first technical paper of the day was LTI Professor Vittoria Rosatto's paper on "The Interrelation of Fashion and Quality." Professor Rosatto was ill and her paper was presented, with several "chapeau" changes, by Prof. Russell L. Brown. Her paper ably described the fashion market. The following are excerpts from her paper stressing the importance of fabric.

Fabric—Fashion's Life Line

The fabric used in creating a fashion is the life line of the fashion. The fabric is supplied by high quality mills that cater to the suggestions of fashion designer. The cut and drape of the new garment depend largely on the response of the fabric. Every detail of a high fashion creation must be perfect; the fiber used, the yarn processing, the fabric construction must not only be good, but must be supplemental and compatible to provide the right detail and workmanship. Fabric quality and high fashion quality are tops; they are a perfect union for a moment. The life of a high fashion, however, is short, and quality of the fabric outlives the fashion many times over. This is not normally so in mass-produced garments.

The fabric appeal, which is most important in garment sales, revolves around surface interest of the fabric. This surface interest inspires the molding or fashioning of a new silhouette by the designer

Textile mills strive to produce fabrics of appeal, for appeal is the major contributant to selling. Quality in a fabric or garment is expected for the price paid.

On "identification" of fabrics, her paper stated it would be more sensible to plough dollars back into development of more foolproof and reliable fabrics rather than into the development of diversity in fabrics as sales gimmicks. There

Speakers of the day pause to discuss topic of the day. *Left to right* are Oliver P. Beckwith, Walter J. Hamburger, ASME President W. F. Ryan, Harold W. Ball, chairman, J. K. Frederick, and R. L. Brown who delivered Prof. V. Rosatto's paper. More than 100 attended the ASME Textile Conference at Lowell Tech.

57—IRD-5 Practical Aspects of Relay or Pulse Servomechanisms, by HAROLD ADKINS

57—IRD-6 Correlation Functions and Noise Patterns in Control Analysis, by HERMAN THAL-LARSEN

57—IRD-7 Dynamic Study of an Experimental Pneumatic Process-Pressure Transmitter, by E. F. HOCHSCHILD

57—IRD-8 Analysis of the Transient Response of Nonlinear Control Systems, by P. E. W. GRENSTED

57—IRD-9 An Analog Study of a High-Speed Recording Servomechanism, by J. W. SCHWARTZENBERG

57—IRD-10 Statistical Treatment of Sampled-Data Control Systems for Actual Random Inputs, by MASAHIRO MORI

57—IRD-11 Design of Multivariable Optimum Filters, by J. H. WESTCOTT

57—IRD-12 Design of a Self-Optimizing Control System, by R. E. KALMAN

57—IRD-13 Some Dynamics of The Golf Shot, by A. J. WILLIAMS, JR.

57—IRD-14 Dynamic-Response Study of a Mechanical-Hydraulic Frequency Discriminator Governor, by C. C. CHRISTIANSON

57—IRD-15 Dynamic Field Tests of a Steam Turbine, by P. R. HOYT, B. D. STANTON, and D. C. UNION

57—IRD-16 Dynamic Field Tests of a Process Furnace, by P. R. HOYT, B. D. STANTON, and D. C. UNION

would then follow the identities of fabrics with pride, rather than hesitancy.

The interrelation of quality and fabrics is a close one in substantial fabrics and garments. One is dependent on the other for success, with appeal for desire and performance for satisfaction. Standards are extremely difficult to set, and more difficult to hold with so many variables existing in the business. Perhaps it would be ideal for the cutters to make the fabric, and the stores to provide dry cleaning and laundering.

Prof. J. K. Frederick, chairman of textile manufacturing and technical director of testing at LTI said that at least one company was already working on a basic package control involving nucleonic and electronic principles which would well solve the ever-present uniformity problem. He added that radioactive isotopes were to be used in the sensing controls.

He reported that work was being carried out on electrostatic cleaning and drafting of fibers before spinning that seemed to hold great potential.

In developing his talk on "Quality and Textile Machinery," Professor Frederick noted that there was a definite need for feedback devices in the textile machinery to correct beforehand, instead of overcoming defects later on.

The "Autoleveller" on the gill box is an example of what has been done in a small mechanical way, he pointed out. "Why can there not be spun yarn without the mechanical combing out of defects and the mechanical drafting afterwards?" he asked.

An idea expounded by several speakers of the day was that the industry is coming to the realization that beating the yarn up fiercely in many of today's processes is costly, unnecessary, and responsible for many quality problems.

Professor Frederick stated that many of the higher quality machines that had come into usage had not necessarily produced better products, but rather allowed faster and cheaper output.

He cited the pin drafter replacing the large number of smaller steps; ring instead of mule spinning of wool; and the modern loom which does not necessarily make better cloth than its Colonial counterpart, but just more speedily. Furthermore, machines like the tensionless dye jig and the high-precision nylon drafting frames have contributed significantly to quality, he noted.

Oliver T. Beckwith, director of quality control, The Wm. Carter Company, Needham, Mass., discussed "Quality Control Techniques."

President Ryan Addresses Luncheon

The dangers inherent in garment trade production-incentive plans which cause the worker to process seconds, rather than stopping to reject because this would eat into his earnings, were discussed by Mr. Beckwith.

This carries in it the seeds of destruction for us since it is destroying the "craftsmanship" with which we have long been identified and which is essential to human well being, he told the engineers. "Spend more money in process control and then you can reduce the present 100 per cent inspection," he urged.

Automation will not mean less or no quality control, but more, observed Mr. Beckwith. Studies in other industries show that with a one per cent reject rate, some high-speed machines would incur more downtime than production time. That gives an idea of the tolerances to which industry will be working, he stated.

Guests at the Textile Luncheon head table. Seated, *left to right,* R. M. Jones, R. L. Brown, W. J. Hamburger, ASME President W. F. Ryan, H. W. Ball, and LTI President M. J. Lydon. Standing, *left to right,* J. K. Frederick, K. R. Fox, V. F. Sepavich, O. P. Beckwith, and F. D. Snyder.

Addressing his remarks to the younger men in the audience, President Ryan said that they may be called upon to study subjects which they consider useless in the present textile-engineering scheme of things. However, this knowledge would be of inestimable help in years ahead.

As an example, he stated that some of the electronics firms currently getting a start in tackling textile problems did not have a full knowledge of textiles and that cub engineers would have a job of working in conjunction with the new technology.

President Martin J. Lydon of Lowell Tech greeted the conferees at luncheon and expressed hope that the meeting would be the forerunner of a long series at the Institution. Harold W. Ball, chairman of the ASME Textile-Engineering Division, acted as toastmaster.

W. J. Hamburger of Fabric Research Laboratories, Inc., Needham, Mass., discussing the "Role of Research for Improving Quality," was first speaker of the afternoon session. He forecast that the next ten years would see almost universal adoption of the concept that textile fibers are an engineering material, and that study of their properties and proving of their stress-strain curves would allow them to be engineered as fully as steel in a bridge-building project.

"Right now it is possible to predesign the bulk of basic cloths barring fancies and multiple fabrics, without placing them on the loom, and make them meet their end uses more closely than under the old system," he stated. He paid tribute to the originator of this thinking, Harold DeWitt Smith who presented it in his original Marburg Lecture.

His organization, he reported, had designed a fabric meeting the requirements of parachute canvas for braking aircraft or rocket recovery with a specification of 45 cu ft per minute per sq ft of fabric by this method without ever using a speck of yarn.

This engineering approach contains "the salvation of an industry," he said. The goal is essential properties, not relative excellence in quality, he added, and by this method there can be savings and boosting of quality without even designing new machines, Dr. Hamburger asserted. He said the Government and the chemical companies making fibers had supported this type of approach, but that the prime textile industry had contributed not one penny.

The concluding talk of session by W. F. Atwood, Pepperell Manufacturing Company, Boston, Mass., gave an illuminating talk on solution of case study involving "Cost Versus Quality." He employed tables to illustrate the six steps, namely, determination of machine-hour operating costs over a range of increased speed; determination of unit costs over speed range; determination of savings per 1000 units produced due to cost decrease over range of speeds; determination of loss due to increased number of seconds; determination of net saving over speed range and optimum speed for greatest profit; and graphic correlation of over-all cost versus quality.

Mr. Ball served as chairman of the morning session, while V. F. Sepavich, Crompton & Knowles Corporation, Worcester, Mass., and Division treasurer, was vice-chairman.

At the afternoon session Dr. Kenneth N. Fox of Fabric Research Laboratories, Inc., acted as chairman, and Robert M. Jones, vice-president, Saco-Lowell Shops, Biddeford, Me., was vice-chairman.

First ASME Railroad Conference Given Before Large Chicago Audience

Railroaders invite young men to join ranks, evaluate achievements, and plan for future

THE first Railroad Conference since the organization of the Railroad Division of The American Society of Mechanical Engineers in 1920, was held at the Sheraton Hotel, Chicago, Ill., April 25 and 26, 1957. W. F. Ryan, ASME President, stated in the banquet address that the Division was to be congratulated on the way in which the conference had been conducted and on the large turnout—there were 260 registrations, and over 400 attended the opening luncheon.

President Ryan said that, although it was the Division's first conference, it was the sixth professional division conference that he had attended since he became President. Most divisions contemplating their first conferences would do well to attend well-established meetings to obtain ideas, and they could have profited greatly from the Railroad Conference.

He was pleased to find the average age of the group relatively young—he had expected all octogenarians! But the group should have been even younger. "Engineers belong on the management side of the table from the time they graduate, and the opportunity for learning and personal contacts with those who are responsible for research and decision making, which conferences offer, is extremely important to them." The Railroad Division should give special consideration to the younger members. At a time when so many other fields of engineering appear more glamorous to the young, the enthusiasm of anyone interested in railroading should be whetted, and it should be made possible for him to attend professional meetings.

Opening Luncheon

"There never was a time," according to J. P. Kiley, president, Chicago, Milwaukee, St. Paul and Pacific Railroad, when the railroads were "better suited to the needs of the country's commerce, or styled more competitively."

"In the past ten years, gross tons per train-hour on our railroad have gone up 63 per cent. Freight-train speeds have gone up nearly 20 per cent. Passenger-train performance also has been substantially improved.

"But the best index is an improved transportation ratio. In spite of a rise of 130 per cent in wages and 80 in the cost of supplies, the rise in productivity due to improvements was enough to enable us to shave our cost of doing business.

"On our railroad, we are great believers

J. P. Kiley, president, Chicago, Milwaukee, St. Paul and Pacific Railroad, speaker at the opening luncheon of the ASME Railroad Conference, Chicago, Ill., April 25–26, 1957. Seated at his left is ASME President W. F. Ryan.

Johnson Mitchell Gunnell Hoppe Seniff

Some of the principals at the ASME Railroad Conference, Chicago, Ill., April 25–26, 1957, included J. A. Johnson, Mem. ASME, American Car & Foundry, coauthor of "Rail Highway Co-ordination"; F. K. Mitchell, Fellow ASME and ASME Railroad Division chairman; B. C. Gunnell, Mem. ASME, and Program Committee chairman; A. G. Hoppe, Fellow ASME, vice-chairman of the session on fuels; R. W. Seniff, Mem. ASME, author of "Special Test Equipment on Railroads"

in the principle of 'brainstorming'—of finding new and better ways of doing things. We hold to the theory that every situation, every piece of equipment, and every method—being the product of some individual's thinking—can some day be improved upon by the creative thinking of some other individual. We try our best to hasten that day."

Mr. Kiley addressed the opening luncheon at which F. K. Mitchell, Fellow ASME and chairman, ASME Railroad Division, presided. He included examples of the new types of cars his line has developed. Progress in signaling and communications, which now make it possible for one man at an electronic panel to control the movement of trains in both directions over 100 miles or more of track with a higher margin of safety than ever before, was discussed also.

Technical Sessions

Both sessions on Thursday were devoted to diesel locomotion; the morning session to utilizing cheaper fuels, and the afternoon session to test equipment. E. H. Weston, Mem. ASME, of American Steel Foundries, indicated the types of cat-cracked and residual fuels that were likely to be available as a result of trends in the petroleum industry.

E. R. Thomas, supervisor of research and mechanical standards for the Southern Pacific Company presented ASME Mem. P. V. Garin's paper on the two-tank "on-off" dual-fuel system used on 53 Electro Motive diesel engines in heavy-duty service. The system supplies a distillate of acceptable quality for starting, idling, and low-throttle position when fuel consumption is relatively low. Less critical, heavier, and cheaper fuel is supplied during high outputs where fuel consumption is at a maximum. A wide range of fuels can be chosen for high-output periods, utilizing those available in any given area.

The Denver & Rio Grande Western, according to R. McBrian, Mem. ASME and director of research, prefers treated fuels, or a blending dual-fuel system to the "on-off" type which supplies either light or heavy fuel. Complete laboratory analyses, engine and road-service tests are necessary to evaluate and condition cheaper fuel properly. The electron microscope has provided an effective instrument for the reduction of particle size to $^1/_{10}$ micron by adding dispersants to relaxed specifications fuels, although dosage varies for each fuel. Combustionwise, such dispersed fuels are the same as a high or 50-cetane specification fuel. Fuels with good cetane ratings but poor cloud and pour points have also been effectively conditioned for winter usage with pour-point depressants plus dispersant. The electron microscope has also been found useful for eliminating fuels which are unstable combustionwise, and which will form lacquers, gums, and sludge.

The discussion for the session included information on the importance for railroad use of distillate and residual fuels. Standard Oil of California's research has produced no data to dispute or support Mr. McBrian on the importance of particle size, although in theory, at least, the smaller the droplet, the more effective the vaporization.

Baldwin-Lima-Hamilton's research has correlated engine malperformance and fuels with the aid of the electron microscope and found that no single additive could be used over the range of available fuels. All discussers agreed that cheaper fuels were available if sought, and assurance was received from the oil companies that prices would not be raised once usefulness had been demonstrated. Engine modifications would be necessary for some, but regional modification was out of the question for a transcontinental railroad which pools locomotives over a long distance.

The New York Central's methods and equipment for testing crankcase and diesel fuel oil were described at the afternoon session by J. A. Smith, manager of the Collinwood Laboratory at Cleveland, Ohio. Eight oil-test stations equipped to make flash, precipitation number, and ash tests on oil samples are located at dispatch points around the system.

The return of engines to the shops on a mileage basis has been eliminated and preventive maintenance aided by the program. A 16-channel direct-reading spectrometer analyzes in excess of 3000 samples per month for the presence of 16 elements, which is regarded as an adequate number for indicating excess-wear rates and amounts of additive metal present.

An electron microscope, in addition to use for fuel-oil control, particularly determination of desirable additives and particle size, offers many possibilities for research once the chemical composition of the observed structures has been determined. Other research equipment in the Collinwood lab includes a 3-meter spectrograph for particular uses in metal and paint pigment analyses. An infrared spectrometer will be used for studying lubricating-oil additives and their chemical changes during use, or exploring vehicles, and drying oils.

Mr. McBrian commented that spectrographic control of electromotive units has saved $3000 per year per unit on the

Corrosion problems and the use of aluminum were discussed at a session of the Railroad Conference by these participants. *Left to right,* Session Chairman B. B. Watson, Mem. ASME, Pennsylvania Railroad; C. O. Currell, Kaiser Aluminum Company, author of a paper on aluminum in freight cars; J. W. Crossett, Mem. ASME, International Nickel Company, who spoke on corrosion; G. B. Hauser, Mem. ASME, Aluminum Company of America, who also spoke on aluminum; and session vice-chairman R. C. Williams, Mem. ASME, Standard Car Truck.

D&RGW. No standard is set for analyses, but each locomotive sets its own pattern of metallic contaminants and month-by-month analyses serve as trouble indicators.

As of Jan. 1, 1956, 16 American railroads were using spectrographs, nine had electron microscopes, and railroad research utilized x-ray, gamma-ray, and ultrasonic nondestructive inspection techniques, according to R. W. Seniff, Mem. ASME and Baltimore & Ohio's manager of research. One railroad operates an outdoor optical-test range for evaluating signal visibility under all atmospheric conditions, and as affected by weathering, indicating the range of railroad-research problems which require the use by the B&O of personnel trained in 17 different specialties. This is quite a contrast to the time recalled by the session chairman, ASME Mem. Eric Wynne, of the Canadian National, when "the feedwater man used to come around with a pocketful of cigars. He knew a lot about cigars, but not much about feedwater treatment."

A session on cars agreed with J. L. Haynes's paper title that "Roller Freight Needs Better Trucks," but bearing, truck, and foundry representatives questioned some of the specific recommendations. Similar disagreement was expressed on ASME Assoc. Mem. W. D. Wallace's paper with "Draft Gear Development." Mr. Moseley of the AAR's Draft Committee summed up by stating that lading damage is costing $100 million per year but there were two schools of thought, one favoring the friction gear, the other the rubber gear.

Rail-highway co-ordination by N. E. Carlson, Mem. ASME and J. A. Johnson, Mem. ASME, was a presentation of the piggyback system, including special hitches and loading methods, developed by American Car & Foundry. One railroad has obtained $1 million of new revenue in a single month during the second year of piggyback operation.

The concluding session on Friday afternoon considered methods of dealing with the $410 million-a-year lost through corrosion. Two papers were presented on railroad use of aluminum. Special properties in regard to weight, chemical resistance, and electrical characteristics of aluminum have suited it to a wide variety of applications, particularly in the development of special-purpose freight cars.

Availability List—Railroad Papers

THE papers in this list are available in separate copy form until Jan. 1, 1958. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	Title and Author
57—RR-1	Corrosion Prevention of Railroad Equipment, by J. W. CROSSETT
57—RR-2	The Expanding Use of Aluminum in Railroad Cars, by G. B. HAUSER
57—RR-3	"Roller Freight" Needs Better Trucks, by J. L. HAYNES
57—RR-4	Test Equipment for Use in Diesel Engine Maintenance, by J. A. SMITH
57—RR-5	Notes on the Use of Catalytic-Cracked Fuels in Diesel Locomotives, by E. H. WESTON
57—RR-6	The Use of Economy Fuels on Diesel Locomotives, by R. McBRIAN
57—RR-7	Rail Highway Co-ordination, by N. E. CARLSON and J. A. JOHNSON
57—RR-8	Evaluation of Railway Draft Gears, by W. D. WALLACE
57—RR-9	Aluminum in Freight Cars, by C. O. CURRELL

ASME Coming Events

June 9–13
ASME Semi-Annual Meeting, Sheraton-Palace Hotel, San Francisco, Calif.

June 13–15
ASME Applied Mechanics Conference, University of California, Berkeley, Calif.

August 11–15
ASME-AIChE Heat Transfer Conference, Pennsylvania State University, University Park, Pa.

Sept. 22–25
ASME Petroleum Mechanical-Engineering Conference, Hotel Mayo, Tulsa, Okla.

Sept. 23–25
ASME Fall Meeting, Hotel Statler, Hartford, Conn.

Oct. 7–9
ASLE-ASME Lubricating Conference, concurrently with ASME-IMechE International Conference on Lubrication and Wear, Royal York Hotel, Toronto, Ont., Canada

Oct. 8–12
ASME-AIME Fuels Conference, Chateau Frontenac, Quebec, Que., Can.

Oct. 21–23
ASME Power Conference, Americus Hotel, Allentown, Pa.

Dec. 1–6
ASME Annual Meeting, Hotel Statler, New York, N. Y.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

(For Meetings of Other Societies, see page 605)

Meeting Competition—Topic of Management Conference

Joint SAM-ASME discussions cover operations research, quality control, and materials handling

MANAGEMENT executives and engineers joined to discuss the techniques with which "Management Meets Competition" at the twelfth annual Management Engineering Conference. The meeting was sponsored jointly by the Society for the Advancement of Management and the Management Division of The American Society of Mechanical Engineers. More than a thousand registrants attended eight sessions of the two-day conference held at the Hotel Statler, New York, N. Y., April 25–26, 1957.

Keynote addresses opening the parallel technical sessions on Thursday morning were delivered by SAM and ASME conference chairmen. The speakers were: Harry M. Kaiser, department manager, Tire Division, U. S. Rubber Company, New York, N. Y., and Hugh A. Bogle, Mem. ASME, and manager, industrial-engineering section, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., respectively.

Featured on the technical program were 16 authorities who discussed techniques used successfully in meeting the demands of competition.

Operations Research

Surveys of operations-research techniques and their development and application in a large and a small company were considered in one of the two Thursday morning sessions. The subject of the collateral session was work measurement and its applications in terms of the theme of the conference. Ralph M. Barnes, Fellow ASME, and professor of engineering and production management, University of California, Los Angeles, discussed work sampling as a means of measuring work. His discussion which included the advantages and disadvantages of random work sampling, was illustrated by a color film "Introduction to Work Sampling."

Wage incentives and quality control were the subjects of parallel sessions on Thursday afternoon. Allan B. Fredhold, Jr., Mem. ASME, and plant manager, General Logistics Corporation, Pasadena, Calif., considered examples of statistical quality-control applications for the small plant. Total quality control, or the control of the quality of the product from its design to its sale, was urged by A. V. Feigenbaum, Mem. ASME, and manager, quality-control service, General Electric Company, Schenectady, N. Y.

At the Friday morning session which discussed materials-handling techniques and their use as tools for meeting competition, Irving M. Footlik, Mem. ASME, and president, Irving M. Footlik Associates, Chicago, Ill., offered new ideas leading to cost reduction in materials handling. Other sessions on Friday morning and afternoon looked to integrated data processing, cost reduction, and management of industrial engineering as aids to management in meeting competition.

View of ASME booth at SAM-ASME Management Engineering Conference, April 25–26, at Hotel Statler, New York, N. Y.

Social Events

High light of the conference was the Thursday evening banquet at which the Gilbreth Medal Award was presented to Harold G. Dunlap of H. P. Hood & Sons. The banquet speaker, William L. Batt, past-president, S.K.F. Industries, and past-president and Hon. Mem. ASME, talked of "Good Management—A Requirement for Peace." His authoritative discussion was enhanced by his experience as Chief of the ECA Mission to Great Britain, 1950–1952, and Minister of Economics and Finance in the U. S. Delegation to NATO, in 1953.

The luncheon speaker on Thursday, Denton Massey, spoke of the challenge of the atomic age. He urged that management meet atomic competition through awareness of the information made available by government research, and proceed to its own developments. Mr. Massey is director of customer relations, AMF Atomics, Inc., and general manager, AMF (Canada), Ltd.

Arthur M. Perrin, Mem. ASME, president, National Conveyors, Inc., Fairview, N. J., was the speaker at the Friday luncheon. He emphasized that management must not only meet competition, but "beat" competition through the competent use of engineering skills.

John V. Valenteen, Armstrong Cork Company, Lancaster, Pa., addresses work measurement session at SAM-ASME Management Engineering Conference. The meeting was held at Hotel Statler, New York, N. Y., April 25–26. Mr. Valenteen covered work sampling techniques in office procedures, maintenance, process production, and job-order production.

ASME Management Conference Held by Region I, at West Boylston, Mass.

Four papers presented by leaders during technical sessions, April 11

THE one-day Management Conference, held by Region I of The American Society of Mechanical Engineers, heard four papers presented by engineers who are working closely with problems of plant operation and personnel. The conference took place April 11, 1957, at the Wachusett Country Club, West Boylston, Mass. Activities started at 2:00 p.m., and there was an afternoon session, a dinner, and an evening session.

Industrial Organization

Two of the papers dealt with industrial organization, while the other two were concerned with the handling of engineering personnel. In his paper, "Integrated Business Measurements in Industry," Allen Keller, Mem. ASME, General Electric, Lynn, Mass., discussed management decisions encountered in job-shop manufacturing, such as GE's steam-turbine production. He defined "business measurement" as the "process of establishing whether the performance of business is good or bad relative to the goals and objectives of the business, and by how much it is good or bad." The word "integrated" meant that measurements were to be made simultaneously over a large number of important areas.

Business measurement had then to be divided into two parts; (a) the establishment of standards of performance by which activities could be judged, and (b) the mechanics of effecting comparisons between actual performance and the standard. When done on an integrated basis over a large segment of a business operation, this is called "integrated data processing." No one will be surprised that Mr. Keller uses a 704 computer which, in about an hour, can read in a two-year shipping schedule, generate a million items of labor from the schedule, and print out the labor requirements by work stations, by weeks, and by months.

T. F. Koch, Assoc. Mem. ASME, Chicago Rawhide and Manufacturing Company, Chicago, Ill., writing on "The Logic of Organizational Planning," urged that organizations be designed with care, from top to bottom. The cut-and-try method of organization is hazardous and wasteful, while the method of allowing one or more dominant elements to create the pattern may work well—until "dictatorship" sets in. Mr. Koch took up the planning of organizational relationships for maximum utilization of capabilities. Such planning eliminates most of the poor arrangements on paper before they are tried, and any poor ones that are tried are watched so closely they have no chance to fail badly.

Engineering Personnel

C. D. Orth, 3rd, E. D. Chapple Company, Noroton, Conn., and F. L. Ryder, Republic Aviation Corp., Farmingdale, L.I., went into problems of engineering personnel, the wise and efficient handling of the engineer as a unit in the industrial organization. Mr. Orth took up "Developing Engineers for Technical Administration," how to find the men who are to become managers, and how to help them develop effectiveness as technical administrators. His presentation faced up to the fact that the best technical men do not necessarily make the best leaders of technical groups.

Mr. Ryder's paper, "The Management of Engineering Personnel," went into the psychological factors involved in selection of men for jobs calling for creativity. He warned against a point of view that places too much store on the "ability to avoid antagonistic relationships with others," pointing out that "The ability to get along with everybody is usually not associated with a purposeful and productive approach to challenging problems, in engineering or any other field."

Plans for 1958 Nuclear Congress:

Industrializing the Atom

INDUSTRIALIZING the Atom will be the key theme for the 1958 Nuclear Congress now definitely set for March 17 through 21, at Chicago's International Amphitheater. With plans well underway, sessions are tentatively scheduled to cover economics, finance, future plans, and much more.

Contribute Papers

All engineers and scientists working in the nuclear field are urged to contribute one or more papers. There were 158 papers from all aspects of nuclear science and engineering at the 1957 Congress in Philadelphia, Pa. Abstracts are due by June 15, 1957, and authors should get in touch immediately with the Secretary of their particular Society, or the Society most closely concerned with their subject. All papers are being handled by individual societies and not by Engineers Joint Council. (All societies in any way connected with the nuclear field are urged to submit papers, whether or not they are affiliated with EJC.)

Co-ordinated by EJC, for its member societies, managed by American Institute of Chemical Engineers, and sponsored by the engineering and scientific societies interested in the nuclear field, the 1958 Congress promises to be bigger than ever.

Once again, the Hot Laboratories and Equipment Conference, and the National Industrial Conference Board's Atomic Energy in Industry Conference will be a part of the 1958 Nuclear Congress.

International Atomic Exposition

A major part of the Nuclear Congress will be the International Atomic Exposition where engineers, scientists, and management men can see and discuss with industrial representatives, all nuclear processes and materials currently available.

At Philadelphia in 1957, a total of 16,429 engineers, managers, and scientists attended the Exposition. With the advances a year can bring to the rapidly growing industry, the 1958 Exposition should attract many more.

Three Leaders

Under the leadership of John R. Dunning, Mem. ASME, chairman of the Nuclear Congress Policy Board; Bruce R. Prentice, Mem. ASME, chairman of the General Committee; and John W. Landis, Mem. ASME, chairman of the NESC Conference Committee, the 1958 Nuclear Congress is expected to mirror all the advances of the nuclear field. Authors are urged to submit their proposed papers to their societies as soon as possible.

ASME Elects Two Fellows

THE American Society of Mechanical Engineers has honored two of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow, one must be an engineer with acknowledged engineering attainment, have 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and be a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who were so honored for their outstanding contributions to their profession and to the Society are:

David Chandler Prince

DAVID CHANDLER PRINCE, formerly vice-president of General Electric Company, Schenectady, N. Y., and now a consulting engineer, has made numerous significant contributions to the field of electrical and mechanical engineering.

From 1942 until his retirement from the General Electric Company in 1951, Mr. Prince was responsible for a large share of the work that was done at that company in the fields of application of atomic power and of jet-engine development. While his contributions in mechanical engineering have been primarily through the direction of the work of others, he took a personal interest in and contributed to the development of novel propulsion equipment for the helicopter, XH17.

Mr. Prince is the author of numerous publications and co-author of two books. He holds 105 patents in various fields of apparatus design and control. He is a licensed engineer in the State of New York. During World War I he served in the U. S. Army as a lieutenant in the Ordnance Department, and was cited "for especially meritorious service in the solution of engineering problems relating to aircraft." The National Association of Manufacturers selected him as one of the "Modern Pioneers of Industry" and he was granted the Modern Pioneer Award in 1940. In 1943, Union College awarded him an honorary Doctor of Science degree.

Mr. Prince served as a member of the Committee on Engineering Opportunities in 1943 for The American Society of Mechanical Engineers. He is a Fellow of the American Institute of Electrical Engineers and was its president from 1941 to 1942. He is also a member of the following societies: American Institute of Consulting Engineers, Institute of the Aeronautical Sciences, Institute of Radio Engineers, Society of Automotive Engineers, American Rocket Society, American Helicopter Society, The Institution of Electrical Engineers (British), and the American Association for the Advancement of Science.

Willis F. Thompson

WILLIS FREDERICK THOMPSON, vice-president, Westcott & Mapes, Inc., New Haven, Conn., has made numerous contributions to the design and construction of power-production plants. Mr. Thompson, a licensed engineer in New York, Connecticut, and Massachusetts, began his career at Westcott & Mapes in 1920 as an assistant mechanical engineer.

Subsequently, he received several promotions: mechanical engineer in 1925; chief mechanical engineer in 1929; director in 1929 to date; and in 1946 he was made vice-president. He is also a partner in Mapes, Taylor, Thompson & Westcott.

He has handled the mechanical design in connection with steam plants for public utilities and industrial plants, office buildings, warehouses, and others; and is now engaged in administrative, executive, and supervisory details in relation to these activities. He was with the Ordnance Department, U. S. Army from 1917 to 1919, designing and constructing steam-electrical generating plants for government-owned arsenals and armories.

Mr. Thompson has served the Society as vice-president of Region I; chairman, New Haven Section; member, Power Show Advisory Committee, Membership Development Committee, National Meetings Committee, Power Piping Code Committee; delegate to Connecticut Technical Council and chairman, Student Guidance Committee; and delegate to Regional Administrative Conference. He has been a director of The Engineering Foundation, and a member of the Engineers' Council for Professional Development and chairman of its Student Guidance Committee. From 1953 to 1955 he was chairman of the Industrial and Harbor Development Committee of the Citizens Action Commission, New Haven, Conn. He has been a director of the New Haven Chamber of Commerce. He is presently a Vice-president of United Engineering Trustees, Inc. and chairman of the Real Estate Committee handling the new Engineering Center. Mr. Thompson is an honorary member of the Connecticut Pi Psi Chapter, Pi Tau Sigma.

ASME President Ryan, *left*, presents Fellowship Certificate to W. F. Thompson during the ASME Engineering Management Conference held in Pittsburgh, Pa., March 27-28, 1957

Junior Forum

Conducted for the National Junior Committee

By H. N. Weinberg,[1] Assoc. Mem. ASME

"Report From Dixie"

By Andrew T. Wuska[2]

In the heart of our new industrial Southland, Birmingham, Ala., the National Junior Committee sponsored on April 8 one of the most interesting and thought-provoking sessions of the 1957 ASME Spring Meeting. The theme of the session, "What Can the Young Engineer Do to Develop Professionally," produced spirited discussion among many "volunteers" from the audience.

The panelists who discussed various aspects of the theme consisted of the following: William B. Speir, Assoc. Mem. ASME, head of the industrial planning department, Rust Engineering Company, Birmingham, Ala.; Erskine Vandegrift, Jr., Mem. ASME, design engineer, American Cast Iron Pipe Company, Birmingham, Ala.; Andrew H. Payne, Jr., Mem. ASME, consulting engineer, Birmingham, Ala.; and John W. Little, Mem. ASME, president, Goslin Birmingham Manufacturing Company, Inc., Birmingham, Ala.

Today, more and more importance is being attached to the professional development of the young engineer in industry. To determine what the young engineer can do to develop professionally, the panel approached the problem from the standpoints of his growth in industry; his aid from the technical society; the value of his obtaining a professional license; and if he really has a place in management.

[1] Process engineer, Esso Research and Engineering Company, Linden, N. J.

[2] Assistant Superintendent, Inspection Department, American Cast Iron Pipe Company, Birmingham, Ala. Assoc. Mem. ASME.

ASME Junior Session Panelists study results of engineering survey. *Left to right,* James Snow, vice-chairman, Ingalls Shipbuilding Corporation, Birmingham, Ala.; John W. Little, panelist, president, Goslin-Birmingham Manufacturing Company, Inc., Birmingham, Ala.; Erskine Vandegrift, Jr., panelist, design engineer, American Cast Iron Pipe Company, Birmingham, Ala.; Andrew H. Payne, Jr., panelist, consulting engineer, Birmingham, Ala.; A. T. Wuska, chairman, assistant superintendent of inspection, American Cast Iron Pipe Company; and William B. Speir, panelist, head of industrial planning department, Rust Engineering Company, Birmingham, Ala.

Mr. Speir emphasized in his statement that "professional development is not something that comes automatically, but rather it must be actively pursued"; the basic burden is on the young engineer himself. He must develop his leadership qualities or his usefulness to himself and his employer is limited.

Actually, the young engineer can get valuable assistance in personal growth from the technical society. Of course, his employer can encourage his interest in the technical society, but the technical society itself must create a sense of belonging to his chosen profession. Mr. Vandegrift pointed out that the technical society can be a guide, philosopher, and friend during the early stages of an engineer's growth and set the pattern for future growth.

Mr. Payne stated that registration as a professional engineer signifies that a man has met certain rigid requirements and is qualified to practice as a professional. He coined the term "technical clerk" which he defined as the people associated with engineering in various capacities who have accumulated an enormous amount of factual data, but still do not have the attributes of the professional. He encouraged young engineers to register as soon as they become qualified.

Mr. Little stated that "many management positions can best be filled by engineers." In order to qualify, the engineer must have "ability, determination, integrity, enthusiasm, and that additional something sometimes expressed as extra effort."

In summarizing all of the discussion, the word "DO" was paramount throughout the session. All parties involved can offer assistance, guidance, and advice, but the young engineer must "do" his part to realize full professional development.

State Boards for Engineering Registration Listing

In keeping with the theme of the spring session, the National Junior Committee would like to be of tangible help to the "Associate-In-Pursuit-of Professional Development." Therefore, we are beginning, with this issue, publication of an alphabetical listing of the addresses and persons to whom inquiries should be directed for each of the State Boards responsible for professional engineering registration. Space permitting, it is hoped that the 48 states and the District

of Columbia will be covered within the next six or eight issues. We are indebted to Prof. John J. Uicker, head of the mechanical-engineering department, University of Detroit, for furnishing us with this compilation.

Alabama State Board of Registration for Professional Engineers and Land Surveyors, Clifton C. Cobb, Executive Secretary, 711 High Street, Montgomery, Ala.

Arizona State Board of Technical Registration, Mrs. Rayma Neeb, Executive Secretary, Room 403, 128 N. First Avenue, Phoenix, Ariz.

Arkansas State Board of Registration for Professional Engineers, V. E. Scott, Secretary-Treasurer, P. O. Box 175, Pulaski Heights Station, Little Rock, Ark.

California State Board of Registration for Civil and Professional Engineers, J. Douglas Locke, Executive Secretary, 529 Business and Professions Building, Sacramento 14, Calif.

Colorado State Board of Registration for Professional Engineers and Land Surveyors, James S. Findley, Assistant Secretary, 20 Capitol Building, Denver, Colo.

Connecticut State Board of Registration for Professional Engineers and Land Surveyors, William K. Simpson, Secretary, 30 Oak Street, Hartford 6, Conn.

Delaware State Board of Registration for Professional Engineers and Land Surveyors, Mrs. Arline J. Honey, Assistant Secretary, 11 East 12th Street, Wilmington, Del.

District of Columbia Board of Registration for Professional Engineers, Mrs. Lacey W. Coad, Assistant Secretary, 1740 Massachusetts Avenue, N.W., Washington 6, D. C.

Florida State Board of Engineer Examiners, Mrs. Ann P. Clover, Executive Secretary, 408 John F. Seagle Building, Gainesville, Fla.

Georgia State Board of Registration for Professional Engineers and Land Surveyors, Cecil L. Clifton, Joint Secretary, 224 State Capital, Atlanta, Ga.

Idaho State Board of Engineering Examiners, S. M. Barton, Assistant Secretary, 623½ Main Street, Boise, Idaho.

Illinois Professional Engineers' Examining Committee, Fredric B. Selcke, Superintendent of Registration, State Capitol, Springfield, Ill.

ASME Codes and Standards Workshop

L. P. Zick, Jr., Appointed to Boiler and Pressure Vessel Committee

THE appointment of Leonard P. Zick, Jr., as a member of the ASME Boiler and Pressure Vessel Code Main Committee was announced on April 11, by William F. Ryan, President of the Society.

Mr. Zick is chief research engineer for the Chicago Bridge and Iron Company and has served on many of the Code Subcommittees, Special Committees, and Task Groups. He has specialized in the design and stress analysis of plate structures and is the author and coauthor of several publications. Mr. Zick is a registered engineer in the State of Illinois, a member of ASME, Western Society of Engineers, Society for Experimental Stress Analysis, and associated member of the American Society of Civil Engineers.

A. J. Ely Receives ASME Award

AT the ASME Mid-Jersey Section meeting held in Elizabeth, N. J., on March 20, 1957, W. H. Byrne, Vice-President, ASME Region II, presented a Certificate award by the Council to Allen J. Ely, a Life Member, in testimony to the high regard of his co-workers and the deep appreciation of the Society for his valued services in advancing the engineering profession as a member of the Main ASME Boiler and Pressure Vessel Committee. He also served on the Executive Committee, the Subcommittee on Unfired Pressure Vessels, and the Subcommittee on Openings and Bolted Connections of this group, and on the API-ASME Committee on Unfired Pressure Vessels. He was active in the coordination of the ASME and the API-ASME Codes for Unfired Pressure Vessels which resulted in the decision to discontinue the Joint API-ASME Code.

In further recognition of his meritorious service while a member of the Committee over a period of 22 years, Mr. Ely was presented a certificate of Honorary Membership on the Boiler and Pressure Vessel Committee by H. E. Aldrich, chairman of the Committee. Prior to concluding his work on the Committee, an informal luncheon was given in his honor at the Engineers' Club, New York, N. Y., by the members of the Boiler and Pressure Vessel Committee.

L. P. Zick, Jr.

A. J. Ely, recipient of an ASME award

Code for Ski-Lifts

THE organizational meeting of Sectional Committee B77, Safety Code for Aerial Passenger Tramways, was held April 18, 1957, in New York, N. Y. The committee approved a revised version of its scope, which will be submitted to letter ballot, and organized subcommittees.

Working definitions of the types of lifts and tows were agreed on, and the chairman, Philip A. Robertson, was authorized to appoint subcommittees on operation, equipment, and maintenance and inspection for wire-rope lifts and fiber-rope tows.

B31 Special Committee on Nondestructive Testing

THE first meeting of the B31 Special Committee on Nondestructive Testing was held March 4, 1957. The special committee was appointed to investigate establishment of proper techniques and standards of acceptance (at different levels of quality) applicable to the materials used in piping and piping components, and the fabrication and erection of such materials.

Included in its charge was the consideration of nondestructive testing in relation to piping in nuclear power plants. V. T. Malcolm is chairman of the special committee.

Actions of ASME Executive Committee

At a Meeting at Headquarters, May 3, 1957

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society, New York, N. Y., on May 3, 1957. There were present: William F. Ryan, who presided; F. L. Bradley and V. Weaver Smith of the Executive Committee; J. O. Amstuz and F. B. Turck, Finance Committee; Joseph Pope, director; J. L. Kopf, treasurer; W. H. Byrne, Vice-President, Region II; E. G. Bailey, past-president; C. E. Davies, secretary; O. B. Schier, 2nd, deputy secretary; and D. C. A. Bosworth and T. A. Marshall, Jr., assistant secretaries.

Recognition of Fifty Years' Service. In recognition of her fifty years of faithful service on the ASME staff, President Ryan, on behalf of the Council, presented Miss Frances Selig with a Certificate of Commendation, a sheaf of letters written by her many ASME friends, and a check.

International Congress for Internal-Combustion Engineers—Secretariat. The Society was authorized to become affiliated with the International Congress for Internal-Combustion Engines with the understanding that the secretariat of the U. S. Committee will be vested in the Society, and the financial and committee support will be provided by the interested Divisions on a basis to be mutually agreed upon.

American Rocket Society. The agreement for reciprocal membership with ARS has been approved.

Miss Frances Selig receives Certificate of Commendation from ASME President W. F. Ryan, *right*, as C. E. Davies, *left*, secretary ASME, looks on. The certificate, presented on behalf of the Council, was given "in testimony of the high regard of her co-workers and the deep appreciation of the Society for her valued services in advancing the engineering profession through her loyal efforts for fifty years."

Research Agreements. Two research agreements between the Society and Syracuse University were approved on behalf of the general research panel of the Joint ASTM-ASME Committee on the Effect of Temperature on the Properties of Metals, as follows:

1 Survey on the effect of Notches on the Creep-Rupture Properties (ASME No. G7:GR-2).

2 Survey on the effect of Cyclic Loading and Heating on Creep and Rupture Life of Metals (ASME No. G7:GR-3).

Applied Mechanics Reviews. The National Science Foundation on April 16, 1957, advised the Society of its grant of $5000 for partial support of *Applied Mechanics Reviews* for a period of approximately one year.

Journal of Applied Mechanics. The Memorandum of Agreement with Brown University for editorial services for the *Journal of Applied Mechanics* has been approved.

Certificates of Award. Certificates of Award were granted to the retiring chairmen of the following ASME Sections: N. F. Gubitose, Anthracite-Lehigh Valley; and J. H. Harlow, Philadelphia.

Certificates of award also were granted to the following retiring Regional chairmen: A. C. Kaiser, Jr., Region IV Sections Committee; and T. J. Judge, Region IV Student Sections Committee.

William F. Durand. The illness of Dr. Durand, the 98-year-old past-president and Hon. Mem. ASME, has been cause for concern. Flowers are being sent regularly on behalf of the Council and the Secretary's office is keeping in touch with his relatives.

Presidential Representatives. The following persons have been appointed to represent the Society:

William H. Pletta, Washington Award Dinner for 1957, April 22; George A. Porter, Michigan College of Mining and Technology, Inauguration of President, May 10; and N. W. Connor, Consolidated University of North Carolina, Inauguration of President, May 8.

The General Arrangements Committee of the 1957 ASME Fall Meeting to be held Sept. 23–25, at the Hotel Statler, Hartford, Conn., is shown: front row, *left to right,* J. Kenneth O'Neill, secretary; Mrs. Richard C. Hurd, Women's Program; Charles H. Coogan, Jr., chairman, General Arrangements Committee; Howard W. Butler, chairman, Hartford Section; David A. Fisher, Technical Events; Back row, *left to right,* are Frank Shires, Hotel; George E. Rowbotham, Printing and Signs; Nicholas Welch, Finance; Hartley P. Smith, Information and Registration; Arthur L. Green, Entertainment; Carl W. Lemmerman, American Rocket Society, Vice-President Connecticut Valley; D. B. MacDougall, ASME Meetings Manager; and Newell T. Johnson, Publicity

Engineering Societies Personnel Service, Inc. (Agency)

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Plant Engineer, BS in business management, BSME, 31; six years design engineer for centrifugal compressors, fans, etc., for air conditioning and refrigeration. Three years test engineer, testing pumps, compressors, and other equipment. Prefers New England. ME-390.

Production Engineer, BSME, MS in business and engineering administration, 34; ten years' experience in manufacturing and production engineering and management. Prefers New England. ME-391.

Engineering Management, small manufacturing company, BSME, 32; ten years' experience in product design and development of heavy industrial machinery. Iron and steel castings, heavy steel weldments. Helical reduction gears. Prefers East or Midwest. ME-392.

Assistant Manufacturing Manager, BS in business and engineering administration, M.I.T., 29; six years' experience in manufacturing methods, product-cost analyses, subcontracting of equipment, and establishment of standards on office paper-work procedures; has worked in and dealt extensively with sales department. Prefers East, South, or West. ME-393.

Mechanical Engineer, BME, June, 1957, 25; summer program—New York Shipyard, Automotive Mechanical; three years U. S. Army—Top 1/5. Member Tau Beta Pi, Pi Tau Sigma. Prefers overseas Europe. ME-394.

Professor of Mechanical Engineering, Dean, BS, MS, and ME; 53; professor of ME, 30 years; chairman of engineering, one year; director of research and development, ten years; (part-time) consultant, four years engine and compressor development, research specialist (two summers). Prefers mild climate. ME-395.

Plant Engineering, BSME, 28; seven years' diversified experience in maintenance, development, layout, design and specification of mechanical and electrical equipment, machine tools, and piping. Fields of work include co-ordination, administration, and technical writing. Prefers metropolitan New York-N. J. ME-396.

Manufacturing Plant Manager, General Manager, BA in chemical and physics; 48; 20 years' experience in nearly all phases of mechanical design, development, and production of hard goods. Knows tool designing and purchasing methods. Was Naval ordnance specialist. Prefers Pacific Coast. ME-397-775-San Francisco.

Test Engineer, BSME; 45; 21 years' experience. Responsible charge testing heat exchangers for large chemical company; World War II and Korean War in charge of railroad shops in maintenance and development of equipment. Released as a major. Prefers West. ME-398-780-San Francisco.

Chief Engineer, BS from UC, ME and EE; 60; wide experience as hydraulic machinery and power-plant designer, engineering office manager, and consultant on hydropower plant projects. Adaptable and versatile. Prefers Pacific Coast or Foreign. ME-399-780-San Francisco.

Power-Department Manager, Engineering Graduate; 41; 18 years in power industry, all phases steam and internal combustion, including design, construction, maintenance, operation, cost, personnel, efficiency, assistant superintendent power station. Location open. ME-400-807-Chicago.

Engineering Administrator, BME, 32, nine years' diversified experience including five in top-responsibility jobs in mechanical design of electromechanical equipment, customer-liaison work, and business administration. Prefers Boston, Mass., area. ME-401.

Positions Available

Teaching Personnel. (*a*) Instructors for industrial-engineering department, MS desirable but will consider a BSIE. Assignment would be in fundamental industrial-engineering subjects with a later opportunity to give advanced courses in production standards, methods engineering, production planning and control, and material handling. (*b*) Associate professor in mechanical engineering, MS degree, at least seven years' teaching experience, or PhD and three to five years' teaching experience. Experience should be in the area of stress analysis, vibrations, elastic vibrations, elasticity, and advanced machine design. (*c*) Instructor, BSME for part-time teaching and research in the fields of either fluid mechanics or in general area of machine design which would include stress analysis, vibrations, etc. Salaries open. Pa. W-4817.

Development Manager, engineering degree or equivalent, ten to 15 years' experience in product design, at least five of which should have been in this field at the project-engineer level. Will direct development-engineering staff handling such products as air conditioners, domestic heating equipment, domestic water heaters. Will collaborate with factory engineers on manufacturing methods and with management and sales personnel in defining new product programs and product-line improvements. $12,000–$16,000. Los Angeles County, Calif. W-4852.

Instructor or Assistant Professor, mechanical-engineering department, to assist in applied mechanics, strength of materials, mechanisms, mechanical engineering laboratory, or heat-power courses. Minimum of $4000 for academic year depending upon experience. Opportunity to work for master's degree. Position starts September, 1957. New England. W-4855.

Chief Product Engineer, 35–40, mechanical, electromechanical, or electrical-engineering degree preferred; courses in business administration, accounting, or economics, will be helpful. Experience should include product development engineering, both line and staff, with small or medium size manufacturer, preferably of internal-combustion engines or at least in a related industry. Experience as development engineer, assistant development engineer, or supervisor of a product development engineering function in a company designing and building internal-combustion engines or other small machinery, is desirable. Salary in five figures; bonus plan; fringe benefits. Midwest. W-4861.

Assistant to Manager, about 30, graduate engineer, some practical experience, for company which develops, designs, sells, and manufactures

[1] All men listed hold some form of ASME membership.

process machinery built in units, mainly for the mining, ceramic, heavy chemical, cement, rock products, and similar industries. Training period. $6000–$7500, plus bonus. Company pays placement fee. New York, N. Y. W-4864.

Personnel Placement Specialist, to work in capacity of supervisor, BS or BA mandatory, preferably in psychology or scientific-MS desirably. Must have knowledge of sources of supply for engineers; will be responsible for the selection and placement of candidates in salary range of $12,000–$20,000. Will supervise placement specialists and supporting administrative and clerical personnel; this includes training staff in psychometrics and most advanced evaluation techniques. When applying, include present salary and placement of employment; this information will be kept confidential. $8000–$10,000 to start. Midwest. W-4875.

Engineers. (*a*) Department manager, graduate engineer, to direct the operation of a new group to conceive, design, and develop intricate mechanisms, and specialized pharmaceutical manufacturing and packaging equipment not otherwise available. Responsibilities will include investigating possible applications of the principles of automation to all operations, and the purchase and installation of equipment to improve automation in all areas. Experience as a developmental engineer in complex devices and some knowledge of controls used in automation, essential. Salary open. (*b*) Senior engineer to act as assistant to the afore-mentioned. Salary open. Detroit, Mich. W-4880.

Professor, mechanical-engineering department, PhD is desired, but will consider a master's degree and suitable experience; should have a leaning toward machine design though sphere of interest may involve any other subjects related to mechanical engineering. Rank and salary will depend on qualifications. Midwest. W-4888C.

Engineers. (*a*) Project and development engineer, ME or BS degree, ten years' experience, qualified to handle development and test of new turbocharged light aircraft engines and allied components. Ability to analyze results and suggest improvements essential. Knowledge of supercharging problems highly desirable. Design and service experience helpful. Salary open. (*b*) Test engineers, engineering degree or equivalent, two years' experience in instrumenting, executing, and reporting tests on internal-combustion engines and allied components. Knowledge of aircraft-engine-test equipment and procedure desirable, but not essential. Salary commensurate with ability and experience. Northeast. W-4897.

Mechanical Engineer, graduate, experienced in inspection of power generating and heating installations. Apply by letter, giving full details of experience and education. $8000–$10,000. Foreign. Headquarters, New England. F-4904.

Product Design and Development Engineer, about 30, graduate mechanical, good analytical ability; strong in thermodynamics, strength of materials, machine design, and mathematics. Must have five years' experience in design and development of mechanical instruments and controls, thermostats, thermometers, or related fields. Experience with manufacturing processes involving stampings, castings, machined parts, brazing, and welding of all types is essential. $6000–$8000. Conn. W-4911.

Purchasing Agent, 30–40, mechanical-engineering degree preferred, five or six years of purchasing or allied experience, for the purchase of chemical equipment and construction materials. $7700–$8900. Northern N. J. W-4913(a).

Instructor or Assistant Professor, engineering mechanics; MS degree for instructor; doctor's degree for assistant professor. Will teach not more than 12 hours a week and will do a certain limited amount of committee work. Sponsored research and consulting work is available for additional income. Salaries: for instructor, master's degree and no experience, about $5000; assistant professor, doctor's degree and at least five years' experience, to $8000. Midwest. W-4927.

Engineers. (*a*) Manufacturing-services engineer, degree in chemical, mechanical, or industrial engineering, or business management, preferably with a master's degree, five years' industrial experience, preferably in pulp and paper or related industries. Appraise performance in decentralized manufacturing operations, with studies in specific problems of operational analysis and improvement. (*b*) Junior manufacturing-services engineer, degree in chemical, mechanical, or industrial engineering. Preferably some practical experience in industrial operations or engineering, for projects involving analysis, appraisal, and improvement of existing and proposed manufacturing operation at pulp and paper mills. Headquarters, New York, N. Y., frequent trips near the Atlantic seaboard. W-4931.

Work Manager, graduate mechanical, general heavy machine tool-shop experience. Company manufactures machinery, equipment, replacement parts. Will head up production, maintenance, and industrial engineering. Company employs 100 to 150. To $15,000. Northern N. J. W-4946.

Engineers. (*a*) Product production engineer, 25–40, to handle basic problems stemming from design to turn over to factory processing production—household appliances. (*b*) Product packaging engineer, 30–40, to set up and direct a small packaging laboratory for household appliances. $7500–$12,000. W-4948.

Teaching Personnel for General Engineering Department. Should be qualified in one of the following categories: engineering drawing and descriptive geometry, industrial engineering. Salaries, nine months: (*a*) Instructor, $3600–$6400; (*b*) assistant professor, $4800–$7000; (*c*) associate professor, $5800–$8800; (*d*) professor, $6800–$10,000. South. W-4957.

Manager of Research-Development Department, graduate chemical or mechanical, to organize staff and direct research and development of products. Patented products already invented and being developed, research chemical, petroleum, paper, food, textile, and mining industries. Management and administration duties include product and process evaluation, patents, field testing, and application engineering. Reports to president. Apply by letter with complete details. Salary open, New England. W-4958.

Senior Industrial Engineer, graduate, ME or IE, experienced in administration of industrial-engineering department, in very large plant and in heavy fabrication and assembly of big equipment. Competent to administer program of plant layout, modernization, and expansion, through large industrial-engineering staff. To $17,000. New York, N. Y. W-4966.

Mechanical Consultant, mechanical degree; experience in design of mechanical components for electrical equipment such as chassis, housing, remote control devices, etc.; familiar with electronics desired. To act as consultant on engineering staff of leading manufacturer of industrial and closed circuit TV. Company pays placement fee and school tuition. $7000–$9000. Northern N. J. W-4967(*a*).

Mechanical, Civil, or Electrical Engineer, for Plant-Engineering Department, 32–38, eight to 12 years' experience in general plant engineering. Previous foundry experience desirable, but not a necessity. Will assist the chief plant engineer in the over-all program. $8000–$10,000. Company will pay moving expenses and placement fee. Pa. W-4975.

Engineers. (*a*) Statistical quality-control engineer, degree in engineering or statistics, experience in statistical quality-control group. (b) Maintenance engineer, engineering degree, experience in maintenance of metals-processing equipment, i.e., titanium vacuum-arc melting equipment and auxiliaries. $7200–$9600. Employer will pay placement fees. Pa. W-4977.

Chief Industrial Engineer, BS or MS in engineering or MBA, to supervise industrial-engineering group, planning and directing work in methods and procedures, job evaluation, standards, incentives, material handling, plant layout, facilities planning, economic analysis, and forecasting. Experience in afore-mentioned functions including supervision of industrial engineering. $8400–$10,800. Company pays placement fee. Pa. W-4979.

Manufacturing Superintendent, engineering or industrial-management degree preferred, at least two years' experience on an executive level. Specifically and intimately familiar with drawing, tinning, stranding, extruding, cabling, and testing operations in plastic-insulated wire and cable manufacturing. Will be responsible for all production, maintenance, and shipping functions. Will supervise and direct activities of production manager and plant engineer. To start, $8000–$10,000. New England. W-4981.

Teaching Personnel, electrical and mechanical, MS desired but will consider a BS, to teach electrical power, electronics, mechanical vibrations, fluid mechanics, and other mechanical-engineering subjects. $5000 up, plus summer and evening if desired. Western N. Y. State. W-4982.

Engineers. (*a*) Methods engineer for electrical components plant. Plant expanding substantially. Vt. (*b*) Junior mechanical engineer to train under master mechanic who is a remarkable inventor and is now introducing many improvements to the industry. New electronics plant; 300 employees. N. C. W-4983.

Sales Engineer, 30–55, graduate mechanical, from an accredited school, for the sale of automatic coal scales for large coal-burning power plants, coal valves, coal feeders, etc. Some experience in the design of boiler plants on staff of engineer, public utility, or large industrial concern, coal-burning power-plant operation, electric utility, or large industrial, sales of large boilers or stokers, combustion control or related equipment. $9000–$12,000. Territory, N. Y. W-4987.

Instructor, teach in the mechanics and physics departments, MS in mechanical engineering or engineering mechanics preferred but will consider a BS; the latter should have some industrial or teaching experience. Should be able to teach applied mechanics, physical thermodynamics, strength of materials, fluid mechanics, graphic statics, and sophomore general physics. All these subjects will not be offered in one semester. Must have strong desire to teach. West. W-4988.

Senior Project Designer, Mechanical or Process, to 50, graduate, able to supervise draftsmen and other designers in preparing plans for chemical-process-plant modifications, extension, or new plants. Should have five years' or more experience. $8400 and up. Employer pays placement fee. San Francisco North Bay, Calif. S-2833.

Air Conditioning, Heat Engineer—Building Constructor; college degree preferably, but not required; 28–40, four to ten years' experience in engineering and estimating for heating and air conditioning, including supervision of installations and sales in building-construction industry. Responsible for accurate estimates, sales, and supervision. $7200 and up. Sacramento, Calif. S-2853.

Sales Engineer, Mining or Chemical-Process Machinery and Equipment, graduate metallurgical, chemical, mining, mechanical, or equivalent, to 35, knowledge of ore milling and beneficiation. Aptitude and interest for sales or application engineering in equipment and machinery line. For world-wide organization, manufacturing a variety of heavy equipment, purchase other items to provide completely engineered and operating setup. Start with client's requirements and end up with detailed flow sheet and operating plant. $6000 and up, plus bonus. Employer pays fee and moving expenses. San Francisco, Calif. S-2870.

Chief Engineer, electrical preferred, 35–45. Will consider mechanical. Should have minimum of five years' experience in equipment and facilities maintenance. Will have full responsibility for maintenance and repair of electrical and mechanical installations, such as air conditioning. Will supervise projects involving partition relocation and painting. $10,000–$20,000. Midwest. D-3861.

Designer Mechanical, graduate, to 38, two or more years in design or project engineering. To design medium and heavy-construction machinery. About 50 per cent board work. To $8400, depending upon experience. Employer will negotiate the fee. Chicago, Ill. C-6207.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after June 25, 1957, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Arizona

JAMES, WILLIAM R., JR., Phoenix

California

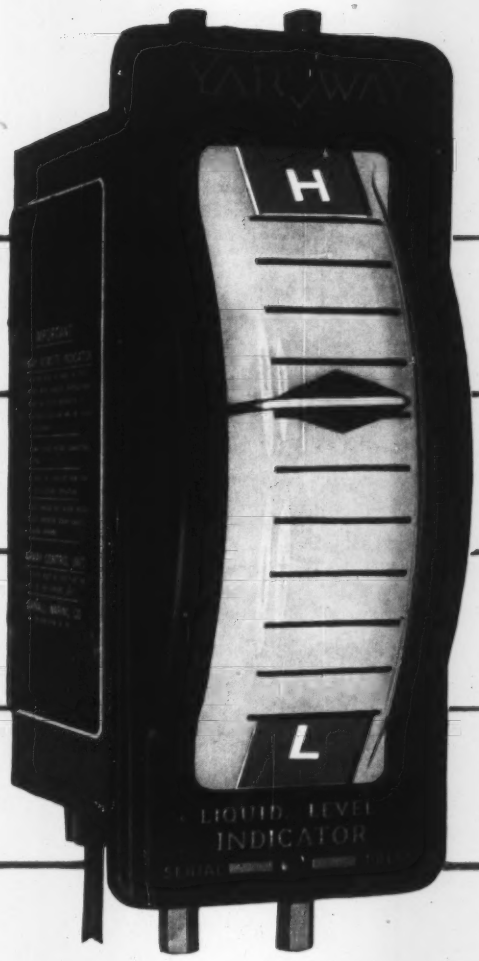
BOTTEMILLER, HARRY E., Redwood City
FAIRALL, RICHARD S., Manhattan Beach
•FRANKS, RALPH W., Lancaster
GREYSON, RICHARD D., Temple City
HENNEBERRY, MARTIN R., Oakland
JUROW, JOSEPH, San Francisco
KOTICH, LOUIS, Fullerton
•MORGAN, CHARLES, San Diego
•REICHERT, DAVID I., Norwalk
SCHMIDT, ALFRED R., San Francisco
SNYDERS, PIETER W., La Mesa
THORNBURN, ROBERT C., San Jose

Colorado

LECKNER, GLENN G., Denver
TAYLOR, CHARLES F., Golden

•Transfer to Member or Affiliate.

(*ASME News continued on page 626*)



boiler water levels now easier to **see**... easier to **read**

Whatever the boiler pressure, high or low, YARWAY Remote Indicators give accurate, instant, eye level boiler water level readings at any convenient plant location.

Boiler Code Case No. 1155* says in part, "... two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi..."

YARWAY Remote Liquid Level Indicators fill the bill—and feature a "wide vision" face that makes reading easier from any angle.

Accurate—because indicator is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum.

Also use YARWAY Remote Indicators on heaters of various types.

For full description, write for YARWAY Bulletin WG-1824.

*Write for free reprint of case description.

Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

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BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY REMOTE LIQUID LEVEL INDICATORS

Connecticut

CLARKE, GEORGE A., Milford
MENCIO, FRANK P., Naugatuck
UPTON, JOHN, JR., Thomaston

Delaware

●FISH, FLOYD H., JR., Wilmington
●OTT, JOHN W., Wilmington
ROMITO, VIRGIL A., Claymont

District of Columbia

CHANDLER, ROBERT D., Washington

Florida

ANDERSON, JOHN T., Orlando
BECKTEL, SAMUEL E., Panama City
ENDRES, JOHN H., Pensacola
HOLMGREN, WARREN L., St. Petersburg
KOBERSTEIN, ROBERT P., Melbourne
ODUM, WILLIAM T., Panama City
WARD, RUSSELL S., Panama City

Illinois

BABCOCK, DONALD, Oak Lawn
BURTON, JAMES P., Brookfield
CHAMBERLAIN, MILTON J., Chicago
CORBIN, HENRY C., Lake Forest
ECKDAHL, JAMES W., Chicago
ECKLEY, WILLIAM A., Northfield
FEJER, GEORGE, Chicago
HACKER, DAVID, Evanston
HAWTHORNE, RICHARD C., Elgin
LUNDBERG, ARTHUR H., Chicago
MURPHY, WALTER P., Chicago
NELSON, DONALD E., Chicago
PHILLIPS, EARL A., Chicago
RAYNER, HOWARD M., Hinsdale
SPAULDING, RONALD R., Chicago
WOLFRAM, ERIC A., Villa Park

Indiana

●BOHNER, EARL A., JR., Speedway
VOLPATTI, RAMON, Indianapolis

Iowa

GJOVIG, ERVIN L., Waterloo

Kansas

MISCHKE, CHARLES R., Lawrence

Kentucky

BARNES, WILLIAM H., Louisville
SCOGGAN, JOHN E., Louisville

Louisiana

GREENE, ARTHUR D., Shreveport
JACHIM, ROBERT, Baton Rouge
LUSE, WALLACE K., Shreveport
MORROW, LIONEL B., Shreveport
SMITH, PERCY M., JR., Baton Rouge
TOWNSEND, DONALD C., Baton Rouge
WEAVER, PAUL E., Baton Rouge

Maryland

●NEILD, ALTON B., JR., Annapolis
ROWE, FRED B., Frederick
●SCHARP, CHARLES B., Baltimore

Massachusetts

CARTER, SIDNEY T., Shrewsbury
●FOSTER, ARTHUR R., Braintree
KUNICA, SERGE, Belmont
OSTERBERG, ANDREW G., East Walpole
●WILLIAMS, JAMES, Westfield
●YEO, ERNEST E., Wenham

Michigan

DELMAAR, RUDY, South Haven
LEUNG, EDWARD Y. W., Ann Arbor
MATHUR, PREM N., Dearborn
●SCHUERGER, RICHARD G., Detroit
TAYLOR, LAWRENCE M., Marine City

Mississippi

MACDONALD, JAMES R., University

Missouri

●HOELSCHER, ERWIN C., St. Louis
REPP, WALTER W., JR., Affton
SPUERING, RICHARD H., Kirkwood

New Jersey

●BLACK, ROBERT N., Glen Ridge
FISCHER, LEONARD O., Fairlawn
KRAUS, GEORGE M., Allendale
●LOFFT, CHARLES W., JR., Collingswood
SCHANCK, HAROLD C., JR., Fords

New Mexico

FRETWELL, JAMES H., Los Alamos
●SLOCOMB, CHARLES A., Los Alamos

New York

BERKS, WILLIAM I., Bronx
CORTRIGHT, STANLEY A., Corning
●DIEFENDERFER, JAMES C., JR., Wellsville
●FELGAR, ROBERT P., JR., Schenectady
HORIGAN, JOHN T., Corning
●KEMPLER, GEORGE, North Merrick
KPOURY, NICHOLAS F., Port Washington
MCCAW, ROBERT F., White Plains
SCHMIEDER, JOSEPH R., Schenectady
SCHNEIDER, KARL H., Brooklyn
SIEGAN, DAVID H., Glen Cove
STRAUSS, WILLIAM H., Vestal
WATKINS, SAM R., New York
ZOCCHI, ALDO C., New York
ZYSZKOWSKI, LEOPOLD H., Roslyn Heights

Ohio

BALLINGER, EDWARD P., Columbus
BROOKS, EUGENE T., Lisbon
COURTOT, LOUIS B., Cleveland
FULTON, WALTER J., Cleveland
●JORDAN, JOHN E., Dayton
●KEEBLER, JAMES C., Cleveland
KELLER, THOMAS C., Canton
KLUBCH, JOHN, Sebring
●LOWE, JOHN R., JR., Chagrin Falls
MCNEIL, ARTHUR P., Alliance
OSPECK, LOUIS C., Salem
ROE, LOWELL E., Toledo
SCARBOROUGH, EDGAR C., Cleveland
STOVER, HAROLD D., Canton
TANKER, GEORGE E., South Euclid
VARKONY, EMERICH, Cincinnati
WAGNER, JACK E., Canal Winchester
WOODWARD, ROBERT E., Dayton

Oklahoma

LOVE, TOM J., JR., Norman

Oregon

LANDERS, ADRIAN L., Corvallis

Pennsylvania

BERNAERTS, HENRY J., York
●BETZ, GREGOR W., Ambridge
BRUMBAUGH, JAMES B., Springdale
COOKE, DAVID H., Pittsburgh
DALGLIESH, JOSEPH, Havertown
ECKBERG, HERBERT F., Lewisburg
GROSSINGER, JOHN S., Johnstown
HANKS, HOMER C., Johnstown
HARRISON, ARTHUR M., Pittsburgh
LORD, STANLEY B., Pittsburgh
MALAY, FRANK L., Pittsburgh
MATTHEWS, VINCENT, JR., Pittsburgh
MILLER, WILLIAM I. E., Johnstown
POTTS, JOSEPH E., Johnstown
REBAR, WILLIAM J., Pittsburgh
●SACKS, BERNARD, Broomall
SCHULTZ, MORTIMER A., Pittsburgh
SMITH, ROBERT J., Erie
TUCKER, FRANCIS J., Philadelphia
VAUGHAN, WARNER G., Bryn Mawr
WINCKEL, RICHARD F., Norristown

Rhode Island

MILLER, HARRY B., Lakewood

South Carolina

LOLLIS, HENRY E., Ware Shoals

Texas

BYRON, LEONARD A., Dallas
DANHOF, JOHN B., Dallas
FARR, ALBERT P., Houston
LOPDRUP, KJELD E., Orange
MALDONADO, SALOMON, Harlingen
MORRIS, GEORGE L., Houston
READ, JAMES M., Baytown
SINGLETON, LOUIE E., Baytown

Virginia

BROSIER, WILLIAM S., Hampton
VAUGHAN, FRANK C., Richmond

Washington

●LOWE, ROBERT D., Seattle
RUDOCK, EUGENE R., Richland
SKOOG, PER O., Olympia

West Virginia

LEROY, GENE, South Charleston

Wisconsin

HERTEL, DUANE W., West Allis

Foreign

MCGOWAN, AUGUSTINE A. P., Toronto, Ont., Canada
MORA-VAZQUEZ, LUIS, Mexico, D.F., Mexico
MURTY, TALLURY B. N., Andhra, India
NORSELL, KNUT B., Stockholm, Sweden
SACHS, ROBERT M., Malton, Ont., Canada
SANABRIA, HERMENEGILDO E., Havana, Cuba
SIMMONS, ROBERT B. V., Hamilton, Ont., Canada
STRANG, JAMES E., Demerara, British Guiana

Transfers from Student Member to Associate Member, Class of 1956 10

Obituaries

Albert Bailey (1875–1957), retired supervisor American Bosch division, American Bosch Arma Corporation, Springfield, Mass., died Feb. 24, 1957. Born, Coventry, England, Aug. 25, 1875. Parents, Sarah (Waring) and John Bailey. Education, Manchester Institute of Technology, 1910; Birmingham Technology School. Married Annie Slater, 1898. Registered engineer in State of Massachusetts. Mem. ASME, 1928. Survived by his widow; a daughter, Mrs. Annie McGillivray; and two sons, Albert, Jr., and Wilfred Bailey.

Norman E. Brice (1889–1957), retired, Liquid Conditioning Corporation, Linden, N. J., died March 10, 1957. Born, Annapolis, Md., Jan. 8, 1889. Parents, Mary Elizabeth (Stinchcomb) and Richard Tilghman Brice. Education, BS, Maryland State College, 1908; ME, Cornell University, 1911. Married Lena Eleanor Hardesty, 1914. Assoc-Mem. ASME, 1918; Mem. ASME, 1935. Survived by his widow; a son, Norman E., Jr.; and two daughters, Mrs. Brice Davis and Mrs. John Morton, 2nd.

Harry Wheeler Brown (1884–1956), who had been a consulting engineer with his own firm, died last November. Born, Allston, Mass., July 17, 1884. Parents, Hattie E. (Smith) and S. Wheeler Brown. Education, SM(ME), Massachusetts Institute of Technology, 1906; SB(EE), 1908. Married Pearle McDuffie, 1917; one son, Russell W. Brown. Assoc-Mem. ASME, 1909; Mem. ASME, 1926.

John L. Eigenbrot (1883–1956), retired assistant to president, General Coal Company, died Oct. 8, 1956, in Baltimore, Md. Born, Baltimore, Md., May 25, 1883. Parents, Louise M. (Zuen) and John L. Eigenbrot. Education, ME, Maryland Institute. Married in 1905; four children, Albert L., Richard L., and Charles W. Eigenbrot, and Mrs. Janet L. Wilson. Married 2nd, Margaret Frances Stevens, 1944. Mem. ASME, 1921. Survived by his widow and four children.

Charles Haggerty (1895–1956?), vice-president, New England Butt Company, died recently, according to a report received by the Society. Born, Pawtucket, R. I., Nov. 23, 1895. Education, Rhode Island School of Design. A specialist in machine design, Mr. Haggerty has had papers published in the technical press. Mem. ASME, 1941. He has served the Society as chairman of the Executive Committee of the Providence Section. Mr. Haggerty served in the U. S. Army during World War I.

Burton S. Hughes (1870–1956), president, Zaremba Company, Buffalo, N. Y., died Aug. 1956. Born, Moscow, Ohio, Oct. 14, 1870. Parents, Malvina and Theodore Hughes. Education, high-school graduate. Mem. ASME, 1908. Married Anna Fisher, 1892; children, Stanley and Elizabeth. Mr. Hughes was a licensed engineer in the State of New York.

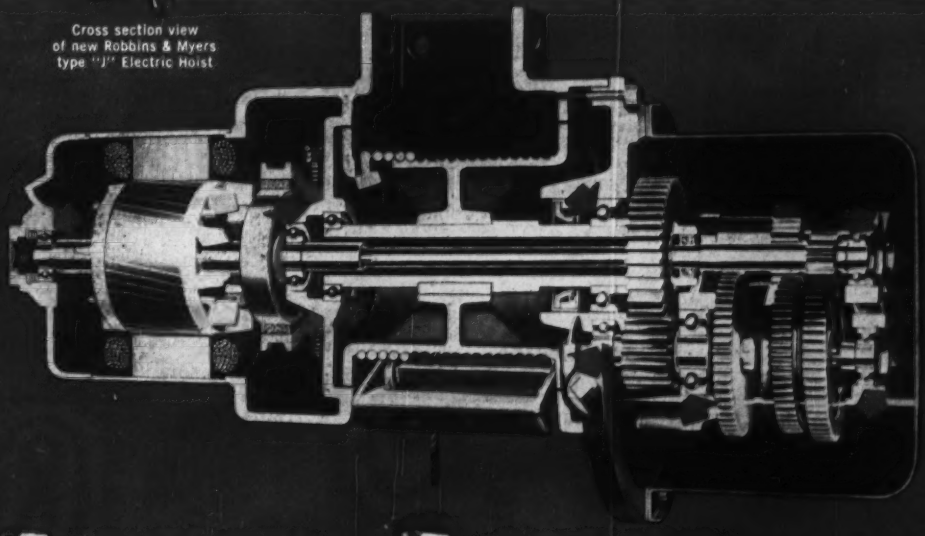
Stiles F. Kedy (1881–1954), who headed his own company, Stoneham, Mass., died Oct. 27, 1954. Born, Mahone Bay, Nova Scotia, April 13, 1881. Parents, Caroline and Alfred Kedy. Education, SB, Massachusetts Institute of Technology, 1908. Naturalized U. S. citizen, 1914, Oswego, N. Y. Married Helen Seymour, 1922; one child, Carolyn. Mem. ASME, 1916. Mr. Kedy was a licensed engineer in the States of New York, Michigan, and Pennsylvania.

Cyrus Henry Loutrel (1885–1957), retired president, The National Lock Washer Company, Newark, N. J., died Jan. 12, 1957. Born, East Orange, N. J., Nov. 26, 1885. Parents, Harriet (Powles) and Cyrus Francis Loutrel. Education, PhB, Sheffield Scientific School, Yale University, 1907. Married Ethel McCluney, 1908. Jun. ASME, 1912; Assoc-Mem. ASME, 1916; Mem. ASME, 1935. Mr. Loutrel held many patents for sash locks and holders, lock washers, and related objects. In 1925–1926, he served the State of New Jersey as a member of the House of Assembly. He served the Society as chairman of Subcommittee No. 2 of the Sectional Committee on the Standardization of Plain and Lock Washers, 1931–1938. He is survived by his widow; and three children, Mrs. Charles

(*ASME News continued on page 628*)

9 PROVEN POINTS OF QUALITY ENGINEERING IN A LOW-COST HOIST

Cross section view of new Robbins & Myers type "J" Electric Hoist



The Fafnir 9100K Series ball bearing is designed basically for applications where housing diameters are restricted and maintenance of relatively large shaft diameters is essential. Available with seals or shields.

The Fafnir 200K Series ball bearing is well suited for applications requiring light to moderate loads combined with relatively high speeds. Available with seals, shields, and snap rings in various degrees of precision and retainer construction.

WHEN the design engineers of Robbins & Myers were asked to develop a low-cost electric hoist that would measure up to R & M standards of quality, they made good use of Fafnir Ball Bearings. They specified them to insure precise alignment of parts, conservation of power, minimum maintenance, reserve capacity for long life. In three critical locations they specified Fafnir Plya-Seal bearings — the bearings that provide superior retention of lubricant and positive protection against contaminants. With these and other construction features, they came up with the design of the new Robbins & Myers low-cost, "J" hoist, *quality engineered throughout.*

Fafnir is a supplier of ball bearings for leading industrial hoists, hoist trucks, and hundreds of other industrial machines and equipment where ball bearing advantages improve performance and prolong service life. In case after case, the choice of Fafnir Ball Bearings is influenced by the Fafnir "attitude and aptitude"—a way of looking at bearing problems from the designer's viewpoint and the ability to supply the right ball bearing to fit the need. Perhaps these attributes can help you solve a bearing problem. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

Gordon Zug, Jr., Cyrus Henry Loutrel, Jr., and John McCluney Loutrel.

William Roy Macdonald (1920–1957), manager, Brown Company, Berlin, N. H., died Feb. 13, 1957. Born, North Brookfield, Mass., April 22, 1920. Parents, Eleaor Mae and Roy Albert Macdonald. Education, New York State College of Marine Engineering, 1941. Married, Eileen Marie Gorman, 1945; children, Mark, Andrea, Geoffrey, and Malcolm. Assoc. Mem. ASME, 1949.

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

ASME Master-File Information

Date

LAST NAME | FIRST NAME | MIDDLE NAME

POSITION TITLE | NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) | Division, if any

*☐

EMPLOYER'S ADDRESS | City | Zone | State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER: e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS | City | Zone | State

☐

PRIOR HOME ADDRESS | City | Zone | State

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Address changes effective when received prior to:

☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ U—Maintenance and Plant Engineering
☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

Ira Emmett McCabe (1894–1957), chief engineer and chairman of the board, The Mercoid Corporation, Chicago, Ill., died Feb. 13, 1957. Born, Chariton, Iowa, Sept. 22, 1894. Education, high-school graduate, 1911. Mem. ASME, 1939. Held 135 patents pertaining to switches and controls. He was a licensed engineer in the State of Illinois.

Daniel James McCormack (1886–1956?), retired sales manager, S. Morgan Smith Company, St. Petersburg, Fla., died recently at his home in York, Pa. Born, Denver, Colo., Aug. 5, 1886. Parents, Margaret (Watson) and Daniel James McCormack. Education, BS(ME), University of Michigan, 1908. Married Alma Wright, 1924; children, Webster Joseph, Daniel James, and Margaret Alma. Mem. ASME, 1918. The author of several articles, Mr. McCormack served the Society in the Hydraulic Division and the Susquehanna Section.

Irving E. Moultrop (1865–1957), retired chief engineer, Boston Edison Company, Belmont, Mass., died Feb. 24, 1957. Born, Marlboro, Mass., July 24, 1865. Parents, Lucy (Rice) and Edwin Moultrop. Education, high-schoo graduate; hon. ME, Stevens Institute of Technology, 1931. Married Z. Abbie Hopkins, 1888. Mem. ASME, 1902; Fellow ASME, 1936; Hon. Mem. ASME, 1946. From 1892 to his retirement in 1935, Mr. Moultrop was associated with the Edison Electric Illuminating Company of Boston. He successively held positions as chief draftsman, mechanical engineer, assistant superintendent of construction bureau, and the company's chief engineer and superintendent of the construction bureau. After his retirement he continued as a consultant to the company and during World War II he acted as a consultant to the U. S. Army, Corps of Engineers. He worked on the construction of numerous smokeless powder plants and also on the construction of the Pentagon Building. His services to the Society have been contributed on the national and local levels. He was a Manager and a Vice-President of the Society, and was a member of the Boiler Code, Power Test Codes, and many other committees. In 1930, he was awarded the Elliott Cresson Gold Medal of The Franklin Institute of Pennsylvania, and in 1942 he was presented with the New England Award of the Engineering Societies of the Boston area. He was a founder and for 12 years president of the Engineers Club of Boston, former president of the Edison Pioneers, and a trustee and member of the corporation of Northeastern University. Survived by a daughter, Mrs. Russel J. Neagle.

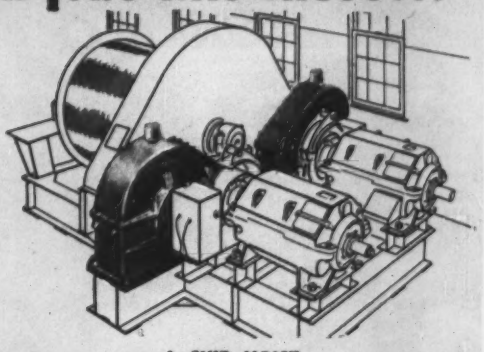
David Robert Shearer (1885–1956), former division manager, East Tennessee Light and Power Co., Johnson City, Tenn., died Sept. 26, 1956. Born, Collettsville, N. C., Sept. 11, 1885. Parents, Mary A. (Estes) and Milton G. Shearer. Education, Universities of North Carolina and Tennessee, and Renssalaer Polytechnic Institute. Licensed engineer in the State of Tennessee since 1935. Married Tiny Curtis, 1910. Assoc-Mem. ASME, 1917; Mem. ASME, 1935. Mr. Shearer was the author of "Electricity in Coal Mining," and over 100 articles published in the technical press. He served as secretary and member of the Johnson City Municipal Planning Board, National Councilor of the Chamber of Commerce, and as a director of many other committees. He was a member of the local council of the Knoxville Branch of the ASME. Survived by his widow

Frank F. Stelz (1894–1956?), specialist in dust collectors, separators, centrifugal air contractors and so on, died recently. Born, Karlstadt, Germany, Oct. 12, 1894. Education, University of Munich, 1917. Naturalized U. S. citizen, 1937. Assoc-Mem. ASME, 1927; Mem. ASME, 1935. He was the author of several articles in the technical press.

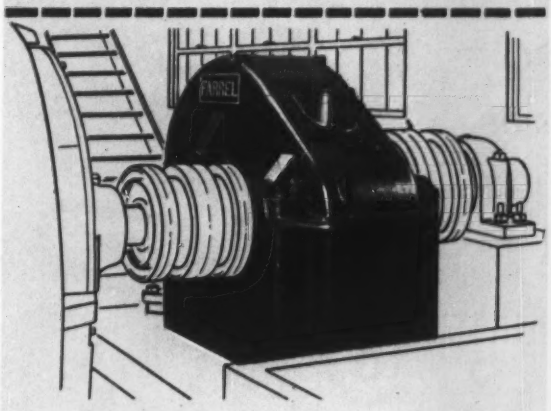
Percy Holbrook Thomas (1872–1957), retired engineer, died March 18, 1957. Born, Boston, Mass., March 31, 1872. Parents, Lurinda (Holbrook) and James Francis Thomas. Education, SB, Massachusetts Institute of Technology, 1893. Married Isabelle Patten, 1900. From 1934 until 1948, Mr. Thomas was with the office of the chief engineer of the Federal Power Commission, developing aerodynamic theories applicable to the design of aerogenerators. He was the author of three monographs issued by the Commission: "Electric Power and the Wind," "The Wind Power Aerogenerator Twin Wheel Type," and "Aerodynamics of the Wind Turbine." Since his retirement, he had been working on scientific research and other inventions. Mem. ASME, 1916. Survived by two daughters, Mrs. H. B. Allen and Mrs. J. M. Hanson.

William E. Wheaton (1884–1957), retired works manager, Walter Scott & Co., Plainfield, N. J., died March 1, 1957. Born, Cincinnati, Ohio, July 30, 1884. Parents, Jennie (Belle) and William Turner Wheaton. Education, ME, Ohio Mechanics Institute, 1921. Married Carolyn E. Latimer, 1906. Assoc-Mem. ASME, 1921; Mem. ASME, 1935. Survived by his widow; one son, William E. Wheaton, Jr., and one daughter, Mrs. William M. Streeton.

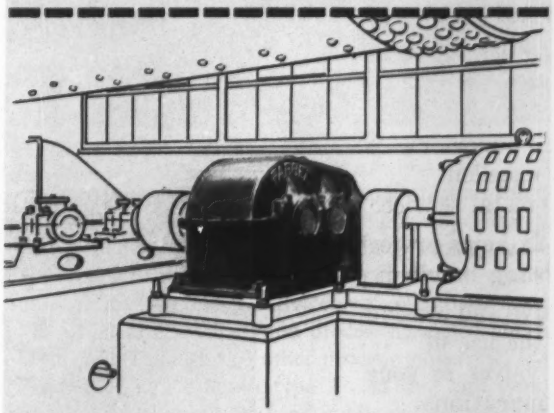
on jobs like these...



. . . A SKIP HOIST



. . . A ROLLING MILL



. . . A ROTARY KILN

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The gears in a Farrel speed reducer are continuous tooth herringbone. Instead of a center groove they have a *backbone* where the helices meet. This *backbone* puts the full width of each gear to work transmitting power, providing extra strength and greater load and shock capacity in smaller space . . . perfect for speed reduction jobs.

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Name the job . . . Farrel has the speed reducer. Both heavy-duty and light-type units are available in a broad range of sizes, and in a series of standard ratios as follows: *Single reduction* — from 1½:1 to 10:1; *double reduction* — from 10:1 to 70:1; *triple reduction* — from 83.9:1 to 323:1. Special designs are obtainable.

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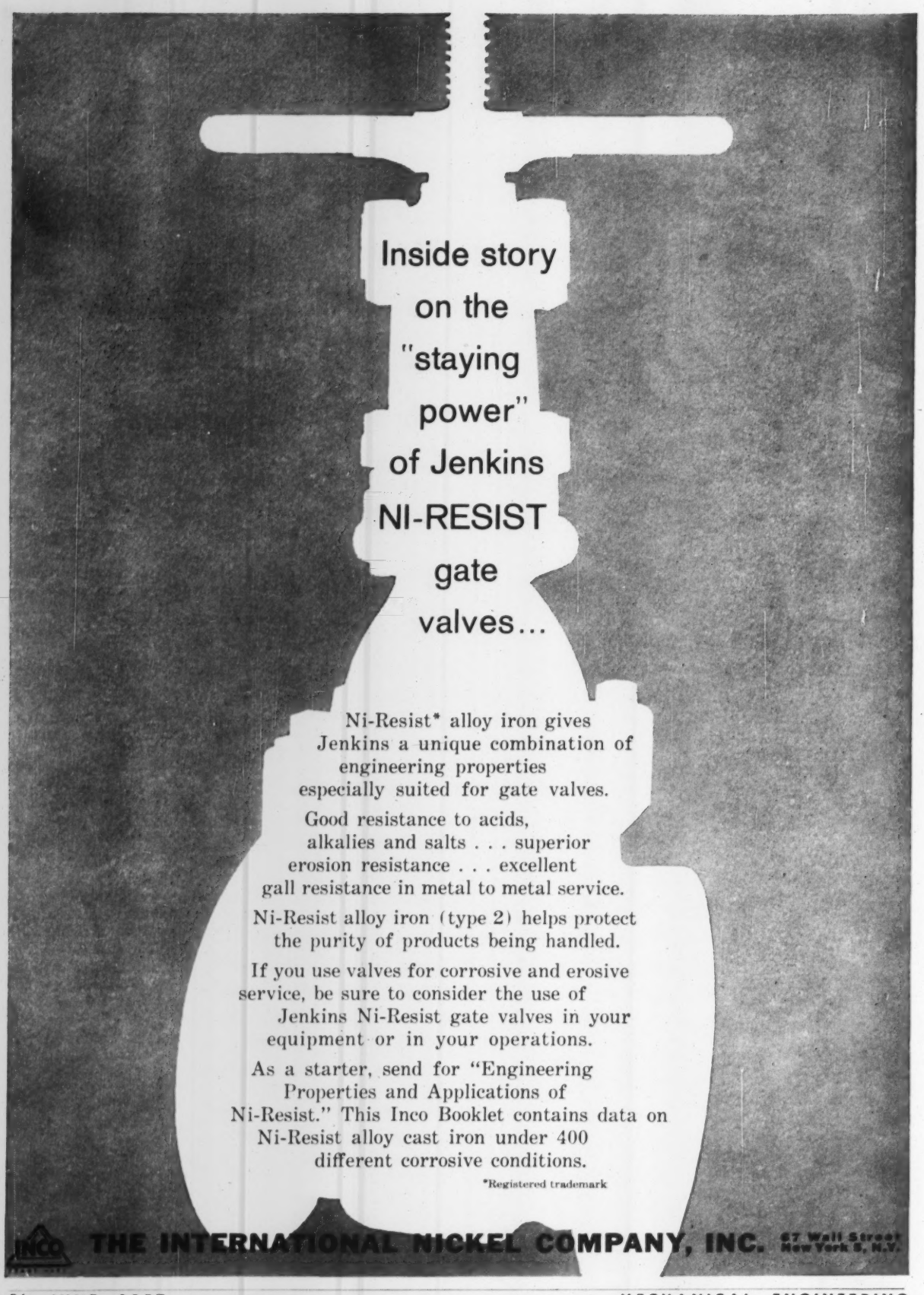
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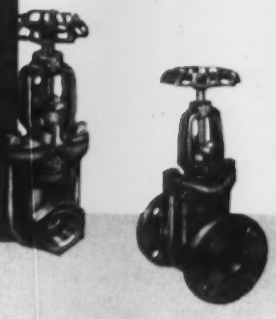
JENKINS NI-RESIST GATE VALVES



Where you encounter acids, salt and alkaline solutions, sea water, brine or other corrosive fluids, vapors or gases, you'll want Jenkins Ni-Resist Type 2 Cast Iron Gate Valves with type 316 stainless steel trim. They have a remarkable ability to withstand destructive corrosion and erosion.

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT

Erasing Machine

Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, announces an electric erasing machine developed especially for faster erasing with minimum fatigue.

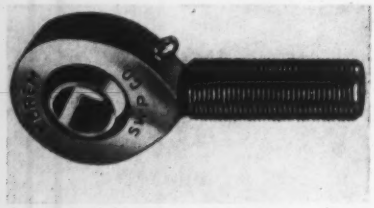
Called the Sovereign, this new machine operates cool under heavy work conditions, has minimum torque and automatic stall control to protect drawings against damage from too heavy pressure, the company reports.

Adjustable Hole Gage

The Kwik-Chek hole gage, a new precision tool manufactured by the Allied Products Div., Hamilton Watch Co., Lancaster, Pa. is designed to permit rapid and highly accurate measurement of small hole diameters.

According to the company, the device is so simple to use that a child can actually gage hole diameters in 5 seconds or less. Accuracy and readability of the gage is 0.0005 in.—the direct reading scale being marked in increments of 0.001 in., and equipped with a $2^1/_2$X magnifying lens. A complete set of three gages covers hole diameters from 0.025 to 0.380 in., each unit having a hole diameter range of 0.125 in.

The gage is composed of three basic functional parts: a tapered retractable needle, a precision clutch mechanism and an magnified scale. Hole diameters are measured in four steps: 1) needle released by pushing the clutch button, 2) needle inserted in hole, 3) barrel pushed down flush with the piece being measured, and 4) gage removed and diameter read directly.



Rod End Bearings

Production of a new line of two-piece (ball and body only) self-aligning, plain, spherical, rod end bearings for the aircraft, missile and related industries is announced by Southwest Products Co., Monrovia, Calif. It is patterned closely after the firm's Monoball self-aligning rod end bearings for aircraft and other critical installations. The new two-piece rod end bearings are claimed to have longer cycle life compared to three-piece rod end bearings due to the construction and tougher materials used.

Called BREM for rod end male and "BREF" for rod end female, the new bearings are said to reduce lost motion in linkages and withstand excessive vibration. They carry heavier loads than anti-friction types since they have a greater surface supporting area, the company states.

The Bearings are available in sizes for $^1/_4$ to $^3/_4$ in. bore and larger, with capacities of radial ultimate loads from 7000 to 33,300 lb and higher. Same bore sizes available for high-temperature operations to 1000F.

Hydraulic Jack

A 100-ton hydraulic jack which can be used horizontally has been added to the line of industrial jacks manufactured by Duff-Norton Co., Pittsburgh, Pa.

According to the company, the jack, weighing 225 lb, can be used either vertically or horizontally because the oil is sealed in reservoirs. It stands 12 in. and has a power raise of $6^1/_8$ in.

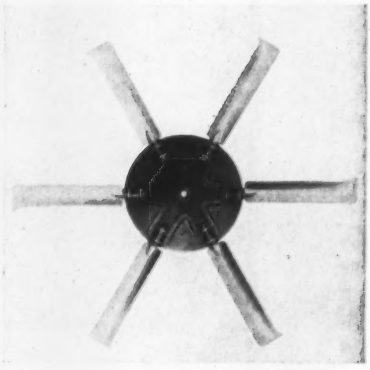
A tandem pump permits rapid engagement of the load. The ram is brought into quick contact with the load by actuating both high speed and high lift plungers. The load can be lifted easily using only the high lift plunger, the firm states.

Dual release valves in the base of the jack can be operated from either side. The base is drilled and tapped for a pressure gage, which is optional.

Diamond Wheel Dressing

Cratex Mfg. Co., 81 Natoma St., San Francisco 5, Calif., announces a new method for dressing and cleaning metal bonded diamond wheels. According to the company, it has been found that rubberized abrasive blocks do a faster and more effective job of removing smear metal and clogging from diamond wheels than previous methods.

Because of its cushioned action, the block flows around the diamond particles, and cleans away the smear metal with minimum danger of knocking the expensive diamond particles loose, the company states.



Cooling-Tower Propellers

Improved large-diameter Al.-metal propellers for cooling towers and heat exchangers are now being offered by the Large Propeller Div. Aerovent Fan Co., Inc., 700 E. Ash St., Piqua, Ohio. They were developed originally for the petroleum industry and allied fields. Cast-aluminum blades are individually balanced to permit interchangeability in any assembly, and to speed and simplify installation and maintenance, the firm says. Heavy-duty cast steel hubs, with bolted blade sockets are designed to resist vibration and stress. Blade root is designed to fit snugly into socket, with a peripheral key engaging keyway in socket for extreme centrifugal strength.

Endurance tests, conducted at three times normal loading, prove the ability of these new large-diameter propellers to withstand severe punishment, the company states.

They are available with four or six blades, in diameters from 14 to 18 ft, with single or multiple-pitch operation.

Stack Bins

A new bin arrangement for storing and handling rubber pellets prevents pellet adhesion, is announced by Richardson Scale Co., Van Haven Ave., Clifton, N.J.

The unit comprises a vertical series of bins, each of which holds 2000 lb of pellets. Pellets are transferred from bin to bin by pneumatic discharge gates which form the bottoms of the individual bins. These gates are actuated by flow control switches and protected by electrical interlocks.

The initial installation, designed for a major rubber processor, consists of a series of 80 of these bins, arranged in 4 double stacks over 4 automatic scales. It is part of an automatic system for controlling storage, proportioning and delivery to mixers of different grades of pellets ranging from dust size to $^{3}/_{4}$ in.

Heat Exchangers

Pfaudler Co., 1036 West Ave., Rochester, N. Y. is marketing a standard line of single and double-pass carbon shell heat exchangers, deliverable within two weeks.

The flexibility of such a standardized line of equipment allows the majority of heat exchanger problems to be solved without the need for special or complicated designs and still have a heat exchanger meeting ASME and TEMA code construction, the company states.

The units are available from prestocked stainless steel heat exchangers in sizes ranging from 56 to 316 sq ft in two weeks. Other sizes up to 20 in. shell diam are assembled from a large stock of flexible-standards including tubing, bonnets, shells, baffles, nozzles, on four to six week delivery basis.

Control Instrument

A control instrument, functioning both as an analog-to-digital converter and as a multi-contact meter-relay, has been developed by Assembly Products, Inc., Chesterland, Ohio.

Within its capabilities, the device is believed by the company to be the simplest and most economical unit available for many control applications requiring moderately accurate digital read-out. These applications include telemetering, automatic testing, multi-grade sorting, reading of maximum values, and accumulating statistical quality control data, the firm states.

The unit also can be used to initiate simple control action at a number of signal points. Thus, the company says, when different grades of alarm or correction are desired, instead of control action at a single preset point, the new device can be substituted for a battery of conventional control components such as meter-relays.

Called the LIAD (Low-Current-Analog-Digital), the instrument operates on small signals passing through a D'Arsonval meter movement.

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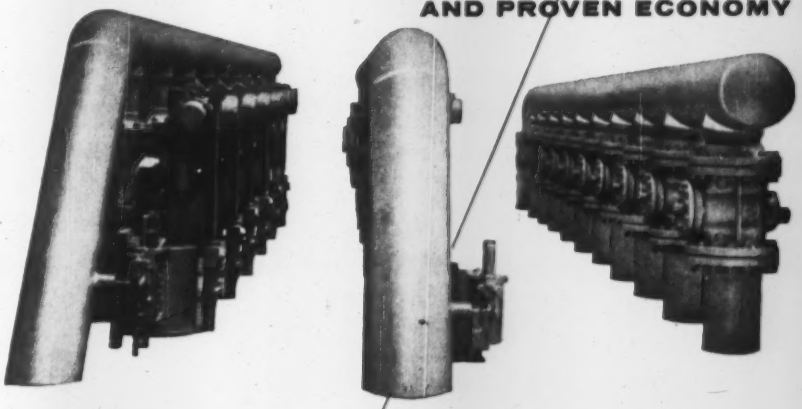
WELDOLETS

FOR ASSURED STRENGTH
AND PROVEN ECONOMY



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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Silicone O-Rings

A line of red Silicone rubber O-rings designated Style 9599 has been announced by Garlock Packing Co., 406 Main St., Palmyra, N. Y. The new rings are manufactured from 70 durometer hardness stock exhibiting low shrinkage and compression set.

They are available in standard AN sizes, and are recommended by the company for dry heat service on which synthetic rubber compounds and natural rubber do not maintain their rubber characteristics. The firm says the silicone rings resist oxidation, withstanding indefinitely continuous exposure to hot air and temperatures up to 300 F, and in most applications will withstand for long periods of time, exposure to dry heat at temperatures from 300 to 500 F.

Altimeter

A new type altimeter, said to be accurate in the high altitude ranges of from 75,000 ft to 225,0000 ft, is announced by Hastings-Raydist, Inc. of Hampton, Va. This instrument makes possible accurate altitude measurements in a range which heretofore has been very difficult to measure, the company reports.

The altimeter operates on 115 v a-c, is unaffected by ambient temperature changes, provides continuous direct altitude reading or recording, has rapid response to altitude changes, holds calibration indefinitely, is unharmed by sudden exposures to any atmospheric pressures, and utilizes a compact transducer with internal volume less than $^1/_{20}$ cu in.

The instrument measures altitude by means of a low pressure sensing element or transducer. This transducer, a noble metal thermopile, generates a d-c voltage which is inversely proportional to pressure. The output voltage of the thermopile increases with increasing altitude. At the higher altitudes this sensing element, without moving parts, becomes much more sensitive than the usual bellows or capsule types of pressure indicators. Maximum sensitivity is in the range of a few millimeters of mercury, a pressure range which is too low for accurate measurement with the commonly used mechanical altimeters.

These sensitive thermopile elements are compensated not only for ambient temperature but for rate of change of temperature by a unique Hastings patented principle. The transducer elements are designed using only metal to glass and have been operated satisfactorily through a wide range of temperatures extending from −300 to 300 F. The elements react very rapidly to changes in pressure and altitude, having a lag of only a few hundredths of a second. The transducer, in addition to having very rapid response, has a volume of only a fraction of a cubic centimeter, and therefore can be connected to pressure tubing with minimum lag effects. The output of the transducer is a d-c voltage which allows remote indicating or recording of the altitude measurements.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Rotary Vane Pump

Lear-Romec Div., Lear Inc., Elyria, Ohio, announces a six-element power driven rotary pump for scavenging and lubricating components of aircraft engines.

The pump consists of three scavenge inlets which have a common discharge port, and three lube discharge ports with one inlet port. The unit is said to be capable of operating in altitude ranges from sea level to 70,000 ft and in ambient and fluid temperature ranges from −65 to +350 F.

Each scavenge element has a minimum rated capacity of 1.5 gpm with a 20 psi absolute discharge pressure. Two of the scavenge elements have a 5 psi absolute inlet pressure and the third element has a 1 psi absolute inlet pressure.

One lube element has a minimum rated capacity of 3 gpm and 100 psi absolute discharge pressure. One has a minimum rated capacity of 0.67 gpm and a 50 psi absolute discharge pressure, and one has a minimum rated capacity of 0.5 gpm and a 50 psi absolute discharge pressure. Each of the lube elements has a 5 psi absolute inlet pressure.

The elements are rated pumping fluid per MIL-L-7808C at 3600 rpm at a fluid temperature of +300 F. The power requirement is 1.5 hp maximum at the rated flow and conditions. One lube element has a relief valve that is adjustable within pressure ranges from 150 psi to 300 psi. The unit also incorporates a plain encased drive shaft seal.

Vertical Gear Shavers

Vertical gear shavers for the precision finishing of large gears have been redesigned and improved by Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

First model of the new line so modified is the V-48, said to be suited for the roadbuilding equipment, turbine, and heavy machinery fields. According to the company, it will accurately shave spur, spiral or herringbone gears up to 4 ft pitch diam, and surface finish them to 12–15 μin.

Two improvements have been made to the machine drive section. The new cutter traverse drive is infinitely variable in a range from .034 to .188 in. per minute, using only two sets of change gears. The improved work drive also is infinitely variable in a range from 1.66 to 241.5 rpm, using only two sets of change gears, the firm states.

Another feature of the V-48 is an integrated checking fixture mounted on the machine column designed to facilitate checking the gear being shaved for spiral pitch and concentricity. Accuracy of the spiral pitch checker is to ±0.0002 in. in 60 in.

The new model retains the principles of operation transverse crossed-axis method of gear shaving with the cutter feeding into depth gradually and at the same time reciprocating across the gear face.

Bridgeport® BELLOWS AND ASSEMBLIES PERMIT GREATER DESIGN FREEDOM

Bridgeport bellows bring an extra measure of strength, safety and stability to any bellows application. And to help you realize these advantages to the fullest, Bridgeport can supply bellows in the best form for your requirements. There's a choice of single or multiple-ply construction, many different heads and ends, sizes from ¼" to 5⅞" O.D., and a wide variety of metals—brass, phosphor bronze, beryllium copper, stainless steel, monel.

With its specialized engineering staff and all-new plant, Bridgeport is also better able to integrate the engineering and production of complete bellows assemblies. The latest high-speed, precision equipment and quality control facilities enable Bridgeport to supply any assembly at lowest cost . . . with uniformly high quality.

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Robertshaw-Fulton CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION • MILFORD, CONN.

Engineering Careers at Curtiss-Wright

Curtiss-Wright's planned expansion and product diversification program creates requirements in 1957, 58, 59, for engineers and scientists in a number of different technical fields and at almost every level of experience. These are permanent, career positions, for this is a carefully planned program. Starting salaries are excellent and are related directly to your education and experience. Company benefits are outstanding and there are adequate provisions for Advanced Study Assistance to those who qualify.

Positions are available in plants located in several states, giving you a choice of geographical location. Work assignments range from pure research in specialized fields to production control of current manufacturing. Products range from plastics for the consumer market to new concepts in powerplants and propulsion systems. Especially interesting to the scientist or engineer are the opportunities offered in the following fields.

AERODYNAMICS	ROCKET PROPULSION
HEAT TRANSFER	THERMODYNAMICS
FUELS & LUBRICANTS	COMBUSTION
METALLURGY	DIGITAL COMPUTERS
NUCLEAR PHYSICS	INSTRUMENTATION
ANALOG COMPUTERS	CHEMISTRY
FLIGHT SIMULATION	AIRBORNE RADAR
JET PROPULSION	PLASTICS
SUPERSONIC AIRFLOW	GUIDED MISSILES
STRESS AND VIBRATION	ULTRASONICS

These are some of the important activities going on in the 17 Divisions of Curtiss-Wright. In such an environment engineering and scientific skills grow and the individual has opportunity to demonstrate his professional ability.

If you are interested in associating yourself with a company which recognizes your individual progress, if you want the stability that comes with diversification of products, then you should send a resume, giving your preference in type of work, as well as your education and experience to:

R. G. Conrad,
Manager, Engineering Recruiting, Dept. G-6
Curtiss-Wright Corporation, Wood-Ridge, N. J.

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CORPORATION · WOOD-RIDGE, N. J.

Switchboard Line

A standardized 14-in.-deep switchboard line that is completely front accessible has been introduced by Square D Co., 6060 Rivard St., Detroit 11, Mich.

Designated as the Series 1 "Power-Style" switchboard, this new line has the same family appearance as other of the company's switchboards, switchgear, unit substations, and motor control centers and is available for services from 400 to 2000 amp.

A variety of service sections with standard current transformer compartments for power company use is available, either in hot or cold sequence with a main breaker or main switch. Where local code permits, these service sections can be supplied with up to six breakers or switches without a main disconnect, the firm reports.

Distribution sections, incorporating molded case circuit breakers, QMB switches or Saflex switches, are connected either by cable or by standard horizontal bus. This bus is designed to permit future connection of switchboard sections as power needs expand. The company says the switchboards can be fed either by cable or bus duct.

Fluid Power Cylinders

A new line of heavy-duty, 3500 psi, standard and large ram, double-acting cylinders designed for dependable, trouble-free, leakproof, long life operation has been announced by Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wis.

According to the company, cylinders are thick-walled, seamless steel, precision bored, honed, polished, and gaged. Eight basic sizes are available with either standard or large diameter rams. Length of stroke varies from 36 in. up to 158 in., with longer strokes available on request.

Choice of foot lug, center lug, and flange head mountings can be combined or interchanged—front or rear—to suit virtually any fixed mount application, the company reports.

Mechanical Brake Motor

A new Cle-Matic brake motor has been announced by Cleveland Electric Motor Co., 5213 Chester Ave., Cleveland 3, Ohio.

It is the third in the series and is a polyphase motor with the built-in mechanical brake. It is designed for quick releasing and fast braking and high braking torque is available. It is especially designed for precision stopping, braking overhauling loads, as a holding brake, a hoist brake and to stop motor coasting between operations.

Solenoids and coils are eliminated. The magnetic field of the stator releases the brake when starting and the permanent magnet applies the braking force when current is turned off. Braking torques are easily adjusted from the outside with a screw driver.

Motors are available in polyphase designs, 1800, 1200 and 900 rpm and some slower and multispeed designs.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Nuclear Purifier

Permutit Co., 330 W. 42nd St., New York 36, N. Y. announces the development of a disposable ion exchange unit, Model XP15 nuclear purifier, designed to reduce the cost of removing dangerous radioactivity.

The purifier measures 15 in. in diam by 40 in. overall height and may be used for cation exchange, anion exchange, or mixed-bed demineralizing; the company says. It may also be used with granular activated carbon to filter and to adsorb organic impurities.

Contaminated water is passed through the purifier, where the radioactive ions from the solution are exchanged onto the resin bed for non-radioactive ions from the resin. As a result, the firm states, the radioactivity from the solution is adsorbed and concentrated on the resin bed. The solution that leaves the purifier is said to be essentially free from radioactivity and may thus be safely disposed of or possibly recycled for reuse. The purifier is designed for compactness and for immediate, low-cost installation, using snap joint couplings.

Tool Steel

A new tool steel that is said to give better machinability and at the same time give better finish is now available, it is announced by Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa.

The new steel is called Oilgraph-EZ and the improved combination of properties comes about by adding a small amount of sulphur (0.10 per cent) to the analysis of the steel.

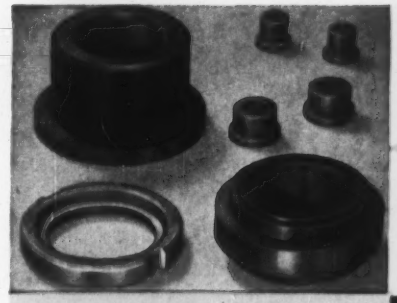
In the new steel the small amount of sulphur added is equivalent to about .25 to .30 per cent of graphite in machinability. Graphite in steel makes the steel easier to machine, but when the graphite gets beyond about .50 per cent it adversely affects the finish of the steel, the company reports.

By adding .10 per cent sulphur to Oilgraph-EZ, which has a graphite range of from .20 to .40 per cent, the graphite and sulphur act the same as if this range were .50 to .70 per cent graphite. This makes the steel unusually easy to machine, and at the same time retains its good finishing characteristics.

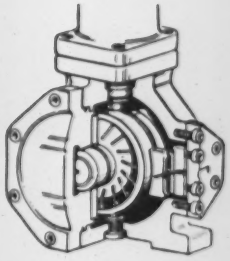
In explaining the action of the sulphur and graphite on the steel, research personnel at Allegheny Ludlum report that the sulphur and graphite particles act as a continual and constant lubricant while machining takes place.

The limited graphite particles are dispersed evenly through the steel and increase the resistance to wear and galling in service. The addition of this sulphur does not adversely affect the other properties of the steel, the firm reports.

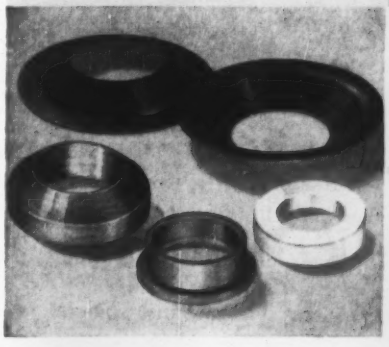
In test applications this new steel has given excellent performance under actual production conditions according to the company. Oilgraph-EZ has been used success-

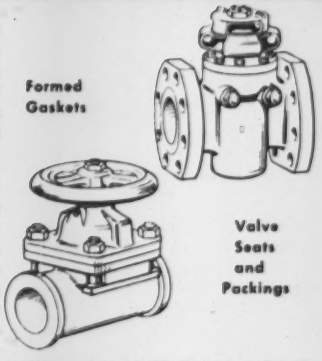


FOR:
Guide Bushings, Vanes and Wear Rings



HAVE YOU CONSIDERED THE IMPORTANT ADVANTAGES OF FILLED TEFLON*?





It has been definitely established that the value of Teflon can be considerably enhanced by the use of fillers in certain applications. Laboratory and field experience has demonstrated that the use of fillers permit Teflon to be more readily tailored to a wide variety of chemical, electrical and mechanical applications. Also, some mechanical properties can be improved. These include:

1) resistance to deformation under load
2) resistance to wear
3) thermal conductivity
4) compressive strength
5) hardness

By thus improving its properties, Teflon now offers even greater industrial potential. This is the reason filled Teflon has become an important item in the "John Crane" Chemlon® line of better Teflon products.

Chemlon is available with such fillers as glass fiber, carbon, graphite, copper and bronze, talc, calcium fluoride and other inorganic materials.

Tell us about your requirements. We'll tell you the advantages you can get from filled Chemlon. Request Bulletin T-104.

Crane Packing Company, 6414 Oakton Street, Morton Grove, Illinois, (Chicago Suburb). In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

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THREAD COMPOUNDS

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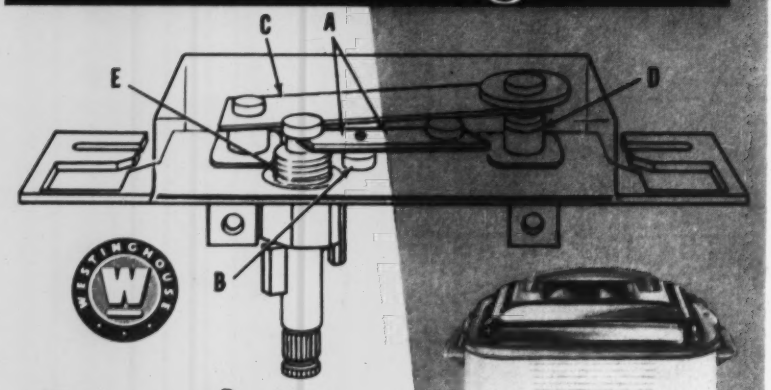
HOW CHACE THERMOSTATIC BIMETAL CONTROLS THE Westinghouse



Roaster Oven

A Product of
Westinghouse Electric Corp.
Mansfield, Ohio

A versatile servant is the new Westinghouse Electric Roaster-Oven which can be used to bake anything from a 14 lb. turkey to a complete oven meal. With its accessory, the broiler grid, it also can be used for broiling, grilling and frying. Of course, the actuating element in this modern appliance is reliable Chace Thermostatic Bimetal.

Here's how it works: The thermostatic bimetal element (A) is mounted freely on the fulcrum pin (B), in a position exposed to radiation from the roaster heating element. The current is carried by the leaf spring (C) through the contacts (D). As the ambient temperature in the roaster increases, the bimetal element (A) deflects in the direction of the spring (C), until the insulated tip presses against the spring and opens the contacts (D). The temperature then drops, the bimetal returns, the contacts meet and this cycle repeats. Since the notched end of the bimetal element is engaged in the groove in the threaded stem (E), turning the control knob clockwise moves the bimetal away from the spring, thus prolonging the contact time and raising the cooking range.

Remember Chace when you design for temperature actuation or indication, or for protection of valuable equipment. Dependable Chace Thermostatic Bimetal is available in 28 types, in strip, coil or completely fabricated and assembled elements made to your specification. Write for new 44-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing interesting uses of bimetal and many pages of engineering data.

IT BENDS WITH THE HEAT

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

fully for drill jig bushings of small diameter and for carbon steel taps.

Other applications include gages, punches, dies for forming, blanking, trimming, shanks for carbide tools, machine spindles, bodies for inserted-tooth cutters, arbors, guides in grinders and straighteners, and other machine tool parts.

The new steel is now being made in production amounts for use in the trade, and can be obtained in bars and bar stock.

Diaphragm Valves

A line of diaphragm-operated high pressure control valves especially designed for automated control is announced by Sinclair-Collins Valve Co., 454 Morgan Ave., Akron 11, Ohio.

Suitable for use in oil, air, steam, and hot or cold water service at pressures up to 6000 psi, these valves are said to offer several exclusive design and construction features. Resistance to corrosion is assured by the Monel metal valve stem, hardened stainless steel seat sleeves and valve bodies of cast Navy M bronze or hi-tensile alloy billet bronze, the manufacturer says. Stellite seats are electro-bonded to the Monel stem and stainless steel seat sleeves are replaceable.

Utility Sets

A redesigned line of Sirocco utility sets said to feature unusual compactness and easy drive accessibility is now available from American Blower Div. American-Standard, Detroit 32, Mich.

The utility sets are recommended by the company for such applications as supplying or exhausting air in small dryers, air cooling electronic tubes and ventilating small enclosures; industrial installations, air cooling processes, and projection room exhaust; laboratory hood exhaust or similar equipment where moisture or corrosive gases are present; forges and oil burners; and supply and exhaust in public buildings, schools, hospitals, hotels, apartment buildings, and industry.

Thoroughly self-contained, the latest utility set design for sizes S 90 to S 360 provides an exceptionally quiet multiblade wheel, accurate aileron control, welded steel construction, adjustable discharge and adjustable motor base, the company reports. Ball bearings are standard in the new design; sleeve type bearings are available on request.

The redesigned V-belt drive arrangement is an overhung design for maximum inspection and maintenance accessibility. All fans have adjustable pitch motor sheaves.

The firm says considerable space saving is achieved with the overhung V-belt design as compared with former inboard sheave arrangements.

The sets are available in four direct-drive designs in addition to the redesigned overhung V-belt drive units. In the direct-drive sets two sizes are available with pressed

Continued on Page 66

Ticket - to your future

Pensacola, Florida
Decatur, Alabama

1957

C 57

GROUND FLOOR ADVANTAGES

CHEMSTRAND

TECHNICAL PERSONNEL MANAGER,
Dept. ME6-57
The Chemstrand Corporation,
Decatur, Alabama

Gentlemen:

It is my understanding that you need for immediate employment graduate engineers in various fields, particularly chemical, mechanical, industrial, textile and instrument engineering.

I am a graduate _____ engineer. Please send me information concerning the ground floor opportunities at Chemstrand.

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Mr. Engineer! Looking for a free ride? Then this is not for you.

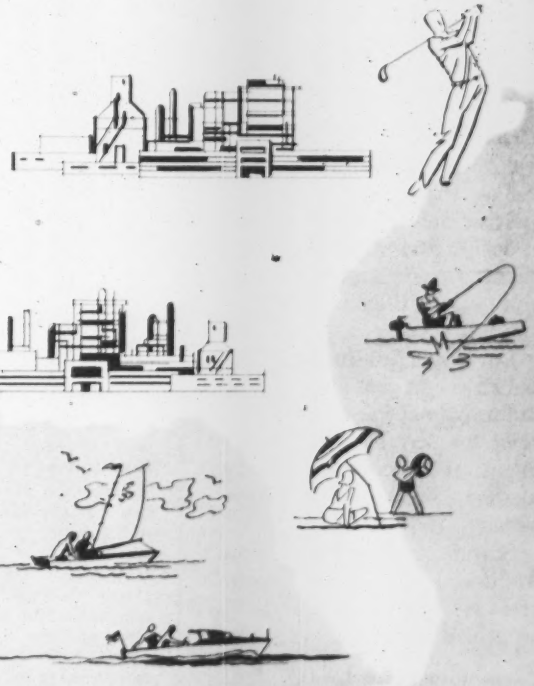
Mr. Engineer! Looking for a future filled with opportunity for accomplishment and recognition? Then this may well be the ticket to your future.

Let's exchange facts. Fill in and mail your ticket today!

★ Chemstrand offers not just a job... but a career.

★ Chemstrand, already a leader in a dynamic, growing industry, is in its sixth expansion in five years.

★ The greatest future for the chemical-textile fiber industry still lies ahead. There is still time to get in on the ground floor... with The Chemstrand Corporation.



CHEMSTRAND

*® Acrylic Fiber by Chemstrand Corporation

ENGINEERS

Chemical, Mechanical, Industrial, Instrument and Textile

Immediate openings available at Chemstrand's Nylon Plant at Pensacola, Florida, and Chemstrand's Acrilan* Plant, General Engineering Department, and Research & Development Center at Decatur, Alabama.

TOMORROW'S BIG DECISIONS WILL BE MADE **by the men who act today...**

EACH PART OF A LOVEJOY UNIVERSAL JOINT IS PRECISION GROUND AND PERFECTLY FITTED

Lovejoy Universal Joints are precision-built for tough service . . . are light-weight, quick-acting to give sensitive response and smooth performance.

Compact construction makes them ideal for close quarter operation. Simplicity of design and absence of complicated parts assure dependability, long life and negligible maintenance.

Lovejoy's full line of standard sizes can provide you with the universal joint that is *just right* for any slow speed application. Special units can be made to individual specifications on request.

Standard sizes range from fractional to 207 hp., diameters ½" to 4", bores ¼" to 2", lengths 2" to 10⅝".

Contact Lovejoy now for complete information. Request bulletin.

LOVEJOY FLEXIBLE COUPLING CO.

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Mfrs. of Flexible Couplings, Variable Speed Pulleys and Transmissions, Motor Bases and Universal Joints.

steel housing and multiblade wheel; five sizes with fabricated steel housing and multiblade wheel; five sizes with cast iron housing and multiblade wheel; and four sizes with cast iron housing and aluminum alloy heat treated wheel with backward-inclined blades. A broad range of capacities in each type of construction is provided. The redesigned units are available in 14 sizes, with or without weatherproof hood.

Lubrication System

A new and advanced Meterflo circulating oil system has been announced by Trabon Engineering Corp. 28711 Aurora Rd., Solon, Ohio.

It is designated Mark II, and includes as part of its system a variable discharge pump and motor unit. Adjustable volume control is available in two ranges, from 5 to 30 and 16 to 100 cu in. per min. According to the company, positive discharge at any setting is assured regardless of required system pressure so that all bearings receive the lubricant they need at all times.

The system has a hi-lo pressure switch which is part of the pumping unit and which is set for wide normal operating range. Inability of any bearing or line to receive oil due to high or low pressure, low oil supply, blocked oil line, will cause the alarm signal blinker lights to actuate.

The hi-pressure dual cartridge filter can be replaced when necessary without stopping the system, the firm states.

Fan-Cooled Air Pump

A new Model 4565 rotary-vane air pump which delivers 45 cfm, twice the capacity of the largest model formerly offered by the manufacturer, has been announced by Gast Mfg. Co., Benton Harbor, Mich.

Designed for continuous, heavy-duty service as either compressor or vacuum pump, the unit is air-cooled by a 10-in. diam pitch fan externally mounted on a rear-end shaft extension. Air is directed by a combination cowl and fan guard which, the company says, eliminates complications common to water-cooling.

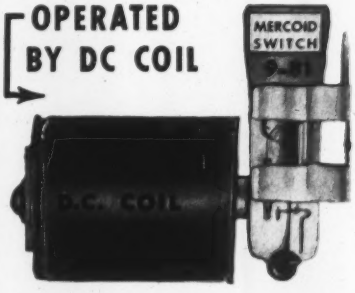
As a compressor, with V-belt drive at 1750 rpm, the unit delivers 20 psig continuously with 5 hp motor. For lower pressures and for vacuum to 25 in. Hg, a 3 hp motor is recommended. Where displacements of 35 cfm or less are adequate, the pump may be operated at 1350 rpm, with 2 or 3 hp motor. Drive with two "A-section" V-belts is recommended by the firm to increase ease of installation and eliminate alignment problems. Fan blades cast in pulley also afford additional cooling.

Quietness and efficiency are said to be increased through use of five composition vanes instead of four. Vanes slide in slots milled and ground in the cast iron rotor. Rotor is mounted on a steel shaft, brazed as one unit, and locked in position at drive end with double-row 206-series ball bearings. Single-row bearings at rear end can be re-

HERMETICALLY SEALED MERCURY SWITCHES

MAGNET OPERATED

OPERATED BY DC COIL



Mercoid Magnetic Mercury Switches remain fixed in position and require only a minute amount of power to actuate the external magnet which in turn opens and closes the circuit. Small DC coils can also be used to operate the switch.

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Has These
ADVANTAGES

HIGH SPEED

Up to 200 operations per minute. Will provide millions of "makes" and "breaks."

SMALL IN SIZE

Switch diameter 33/64", length 2".

VISIBLE OPERATION

You can tell at a glance whether switch circuit is "on" or "off".

PROVED

Backed by 35 years of engineering skill and field experience.

Various types of magnetic switches available. We also manufacture a complete line of tilting type switches. Our engineers are at your service—send in your switch problems or

WRITE FOR BULLETIN NO. 46

THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

moved for inspection or servicing of interior. Body and end-plates are cast iron. Looking at shaft end, rotation is clockwise.

As a compressor, the unit includes 1-in. pipe size automatic lubricator and felt type intake filter, adapted to such applications as atomizing No. 5 or 6 fuel oil on industrial oil burners for packaged boilers. Used as a source of air pressure independent of plant air lines, the pulse-less air delivery of rotary design eliminates need for an air tank, the company says.

As a dry vacuum pump with 45 cfm capacity, the unit can be used instead of two smaller pumps on original equipment applications such as paper or sheet feeding on printing presses, or on packaging and bottle filling machinery. Other applications include pipe-line milking machines and vacuum-mold forming of large plastic sheets.

Net weight of pump with accessories, without base, is 92 lb. Special extra accessories include vacuum and pressure relief valves, line filters, gages. Pump construction is recommended for dry vacuum only.

Fluid Control Valves

Improved fluid control valves for air, oil or water hydraulic use have been announced by Modrich Fluid Controls, Inc., Crystal Lake, Ill. They are designed for pressures of 200 to 5000 psi., in sizes from $^1/_8$ through $^3/_4$ in.

According to the company, the flow control valve combines two types of valves in one compact body design—a floating retro-ball check which provides full flow in one direction—a tapered, fine thread needle which gives a wide range of adjustment of the flow in the opposite or controlled direction.

The valve bodies are machined from hexagon bar of brass and aluminum for 2000 psi working pressures; of steel and stainless steel for 5000 psi working pressures. Other parts are stainless steel. The O-ring packing conforms to JIC hydraulic standards.

Tracing Paper

A new resin-transparentized, 100 per cent rag content tracing paper under the trade name "Vist-Vel" is offered by the Charles Bruning Co., Inc., 4700 W. Montrose Ave., Chicago 41, Ill.

The paper is said to offer exceptional translucency and, by actual test, can boost print production as much as 25 per cent over other transparentized papers. In visual characteristics, it provides a perfect balance of visual opacity and transparency to assure easy, comfortable visibility of drawing surface and line when making original drawings and excellent visibility of underlying image when making tracings, the company claims.

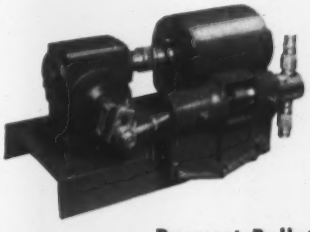
According to the firm, the paper accepts pencil hardness up to 9H without tearing or puncturing and areas can be cleanly erased and re-erased repeatedly without damaging its drawing qualities. This paper withstands heavy handling in drawing, reproduction, and filing because of its exceptional inherent strength, it is claimed.

Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

No Build-Up! No Blow-Up!

. . WHEN MODEL 1106 PROPORTIONEER FEEDS BOILER WATER CHEMICALS

Prevent scale build-up (caused by boiler carry-over) on turbine blades with proper raw water or internal steam boiler treatment. Model 1106 Proportioneer feeds all chemicals (alkaline, neutral, or acid) accurately (guaranteed within ± 1%) over 15 to 1 range. Capacities range from 0.11 to 35.6 GPH . . . for discharge pressures up to 1100 psig.



PAY LESS, GET MORE!

Design features of this proportioning pump include interchangeable measuring cylinders, super-accurate Vane-Guide check valves, and percentage calibrated stroke-length scale.

Request Bulletin 1106-2 for complete data. Write to PROPORTIONEERS, INC., 382 Harris Avenue, Providence 1, Rhode Island.

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Applied Physics Laboratory

ANNOUNCES

. . . important openings on our guided missile research and development staff for men who wish to identify themselves with an organization whose prime purpose is scientific advancement.

Because the Applied Physics Laboratory (APL) exists to make rapid strides in science and technology, staff members require and receive freedom to inquire, to experiment, to pursue tangential paths of thought. Such freedoms are responsible for findings that frequently touch off a chain reaction of creativity throughout the organization. As a staff member of APL you will be encouraged to determine your own goals and to set your own working schedule. You will also associate with leaders in many fields, all bent on solving problems of exceptional scope and complexity.

Equidistant between Baltimore, Md., and Washington, D. C., our new laboratory allows staff members to enjoy suburban or urban living and the rich cultural, educational and research facilities offered by both cities.

Openings Exist in These Fields:

DESIGN: *Airframes and structures; hydraulic and power supply systems; servomechanisms; launching and handling equipment; ramjet engines; warheads.*

ANALYSIS: *Stress; weights and loads; heat transfer; dynamics; warheads.*

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8607 Georgia Avenue
Silver Spring, Maryland

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Stainless Steel Thermostat

Fenwal Inc., Ashland, Mass., has added to its line of Thermoswitch units a new thermostat fabricated entirely from 316 stainless steel. All exterior joints are heliarc welded.

Because of its special construction, the stainless steel Thermoswitch unit, model 18000-26, is especially suited for service in 5 per cent H_2SO_4 at temperatures up to 120 F (or in higher concentrations at lower temperatures), acetic acid vapors, halide solutions, alkaline solutions, and other materials to which 316-type stainless is resistant, the company says. It will provide excellent service in all types of photographic solutions, it is claimed.

The unit is supplied with coupling-head mounting having a $^1/_2$–14 pipe thread for direct threading into a tank or pipe wall. Contacts open above the control setting. Control temperatures are adjustable over a range of −100 to +400 F, and short-time overshoot by as much as 100 deg will not affect reliability. Current rating is 10 amp, 115 v a-c, or 2 amp, 115 v d-c. The cartridge is $^5/_8$ in. in diam, and has an immersed length of 3 in. The thermostat will control within 2 F in a well-designed system.

High Capacity Pumps

For capacities up to 25,000 gpm in the marine, petroleum, pulp and paper, and municipal water works industries, Goulds Pumps, Inc., Seneca Falls, N. Y., has introduced Fig. 3420–3423 24-in. pumps.

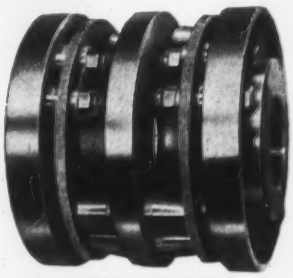
According to the company, both units are exactly the same except for the lower half casing. Fig. 3420 has horizontal suction and discharge, while Fig. 3423 has vertical bottom suction and horizontal discharge.

These single stage, double suction pumps have horizontally split casings with upper and lower half bolted and doweled together. The first states that removal of the upper half casing permits inspection, maintenance and removal of entire rotating element without disturbing suction and discharge piping or pump and driver alignment. The impeller is of the double suction type providing hydraulic balance. It is cast in one piece and all exterior surfaces are machined. It is dynamically balanced and keyed to the shaft. Interior surfaces or waterways are hand finished.

The pumps are fitted with renewable type casing wearing rings designed to maintain proper running clearance with impeller hub and to minimize leakage between suction and discharge chambers of casing. In addition, impeller wearing rings can be furnished when desired.

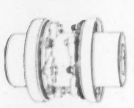
Stuffing box is provided with square packing rings, removable water seal ring, and positively locked renewable stuffing box throat bushing. It has tapped openings for water sealing either from pump casing or outside sources or for use of a lubricator. The stuffing box gland is of the split-cowl type suitable for use with quenching liquids. It

FOR MAINTENANCE FREE POWER TRANSMISSION
Specify
THOMAS
FLEXIBLE COUPLINGS



DOUBLE FLEXING
DBZ — for high speed, heavy duty drives

FLOATING SHAFT
BMR — for heavy duty service with excessive misalignment



DOUBLE FLEXING
AMR — for engine and medium speed drives

SINGLE FLEXING
SS — for engine-driven generator sets with out-board bearings

Thomas' 40 years of flexible coupling experience is at your disposal to help you meet ordinary applications or special variations for unusual cases.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES.

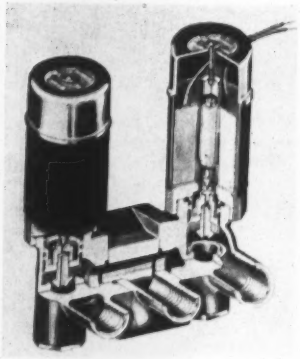
1 Freedom from Backlash Torsional Rigidity
2 Free End Float
3 Smooth Continuous Drive with Constant Rotational Velocity
4 Visual Inspection While in Operation
5 Original Balance for Life
6 No Lubrication
7 No Wearing Parts
8 No Maintenance

Write for Engineering Catalog 51-A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U. S. A.

is provided with packing rings to prevent liquid spraying and traveling along shaft outside the gland. Bearings are grease lubricated ball with grease relief for positive prevention of over-lubrication. Thrust bearing is securely locked in place. Coupling and bearing is free to float axially and takes radial load only. Bearing housings are completely sealed.

Fig. 3420–3423 may also be supplied with ring oiled sleeve bearing on coupling end and ring oiled sleeve bearing with ball bearing on thrust end. Pumps can be supplied with cast iron or structural steel bed plates for any form of driver.



Duplex Solenoid Valve

A 3-way double solenoid valve introduced by the Atkomatic Valve Co., Inc., 545 W. Abbott St., Indianapolis, Ind., is designed to provide unusual flexibility for 3-way flow control applications. The valve is available in three assemblies for mixing, divided flow and cylinder control operations.

As a mixing valve, it has two inlets and a common outlet and it can be supplied with oversize outlets to provide maximum flow. For divided flow, the valve has one inlet and two outlets. Inlet can be supplied larger than individual outlets for maximum flow. As a cylinder control valve, the unit has an inlet, cylinder and exhaust connections. An optional check valve maintains pressure on cylinder in case pressure source fails.

A packless valve with two pilot-piston units, each separately controlled, provides the specified 3-way flow control, the company reports.

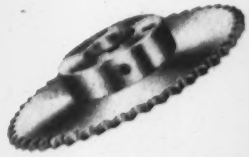
The valve is said to be bubble tight and may be used at specific pressures ranging from 5 to 1000 psi with both pistons normally closed and at 5 to 500 psi with either or both pistons normally open. It is available in $\frac{1}{2}$ and $\frac{3}{4}$ in. pipe sizes.

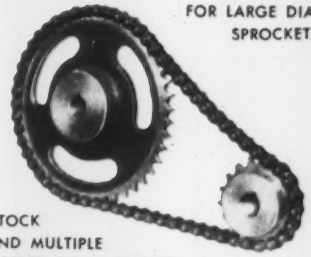
According to the company, the valve may be used on air, water, oil or any fluid not harmful to Navy M bronze. On liquids, controlled closing can be built into the unit to prevent shock, even at high pressures, the firm states.

STOCK BORE SPROCKETS

STEEL AND CAST IRON SINGLE SPROCKETS

CAST IRON HUB SPROCKETS


ALL STEEL SPLIT OR SOLID HUBS FOR LARGE DIAMETER SPROCKETS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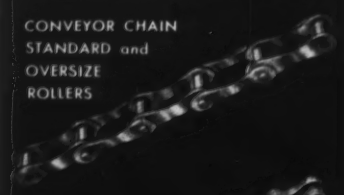
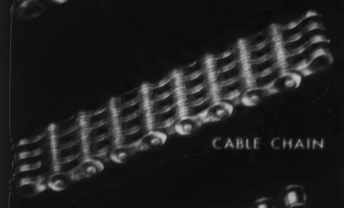
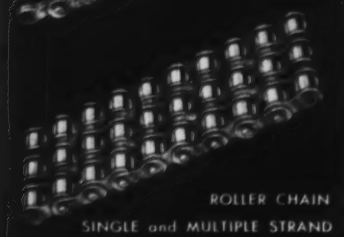

CONVEYOR CHAIN STANDARD and OVERSIZE ROLLERS


CABLE CHAIN


ROLLER CHAIN SINGLE and MULTIPLE STRAND

Call ACME for Service

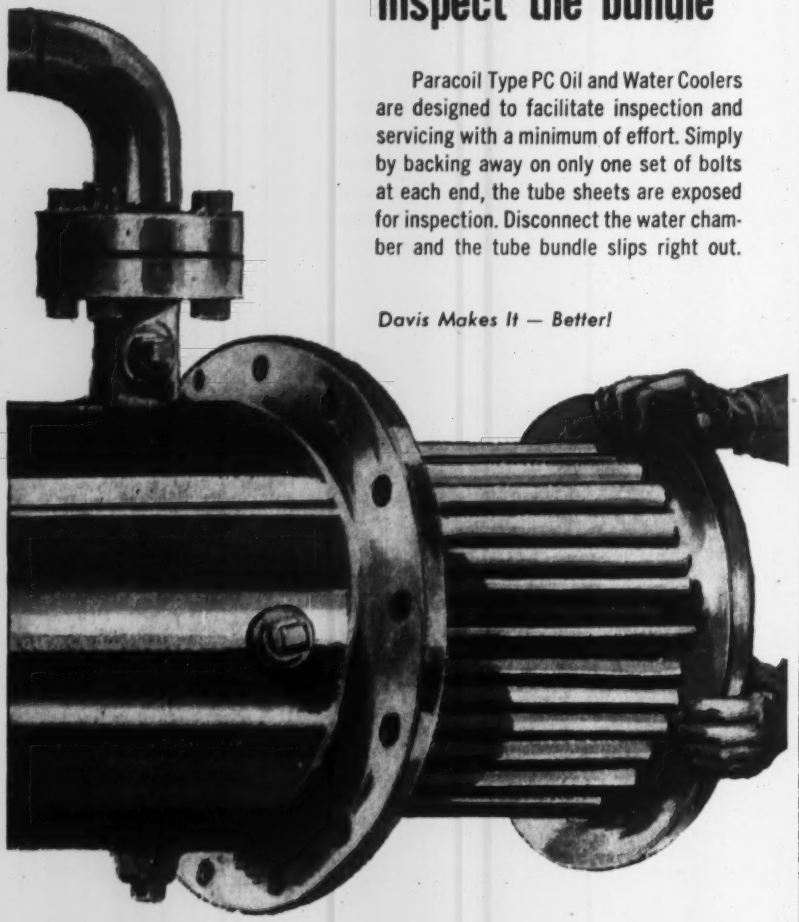
Acme Chain Corporation
HOLYOKE MASSACHUSETTS

Paracoil **OIL & WATER COOLERS**

Remove just one set of bolts to inspect the bundle

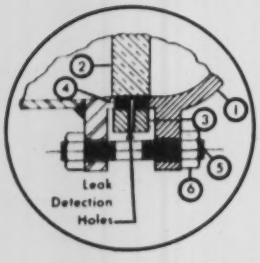
Paracoil Type PC Oil and Water Coolers are designed to facilitate inspection and servicing with a minimum of effort. Simply by backing away on only one set of bolts at each end, the tube sheets are exposed for inspection. Disconnect the water chamber and the tube bundle slips right out.

Davis Makes It — Better!



. . . built with double packed tube sheet for positive leak protection.

Contamination of shell and tube fluids is impossible with this unique Paracoil design. Seepage from either side is immediately detected through bottom copper-lined leak detection hole.



1. Return Channel
2. Floating Tube Sheet
3. Retainer Ring
4. Packing
5. Bolt or Studbolt
6. C. P. Hex. Nut

Write for Paracoil Bulletin 140

DAVIS ENGINEERING CORPORATION

30 Rockefeller Plaza, New York 20, New York · Circle 6-5650

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Vacuum Forming Process

Quick Plastics, 1766 Cooper St., Jackson, Mich., announces a new continuous method for vacuum forming sheet plastic.

The firm explains that sheet is taken directly from the extruder and, while still warm and soft, passed over a vacuum roll where it is formed in the desired pattern. The result is said to be a very low cost continuous sheet of formed plastic. Styrene, polyethylene, acetate and butyrate are being formed by this method and other materials can also be used.

Present equipment makes sheets 24 in. wide in continuous lengths, with thickness varying from .008 to more than .080 in. The formed sheet may be any color, transparent or translucent, the company states.

Electric Chain Hoist

A lightweight electric chain hoist has been introduced for lifting operations by the Wright Hoist Div., American Chain & Cable Co., Inc., York, Pa.

The unit is said to be adaptable for utilization on production lines, over machine tools, or in any shop location where space is at a premium. It is available in two types of reeving: the 300–2000 lb capacity, single-chain unit and the 3000–4000 lb capacity, double-chain unit.

Operation has been arranged for one-hand control with clearly marked handles for Up or Down travel of its hook. Control ropes are attached to a control lever which activates a controller to raise or lower the hook and also act as the limit switch control. The control handle action also manually actuates the brake shoes for release or quick and positive stopping of the motor.

Simplified and compact construction is made possible by the use of a double worm and gear reduction, heat-treated alloy steel chain, load wheel and hooks, the company states. With excess weight eliminated, the hoist frame and gear housing are adequately reinforced at all points of stress, it is reported.

Speed Reducer

Western Gear Corp., Box 182, Lynwood, Calif., announces the design and manufacture of a new in-line series of speed reducers to be marketed under the trade name Straft-Line.

The reducers are available in double and triple reduction. Double reduction units are offered in 15 standard ratios from 3.39:1 to 57.3:1 with ratings up to 100 hp. Triple reduction units are available in 9 ratios from 82.1:1 to 190.7:1 with ratings up to 50 hp.

The units feature complete interchangeability of individual parts throughout frame sizes as well as packaged sub-assemblies, the company states.

Continued on Page 73

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IFC	16–17	29	41	55	69	82T	94	103	122	137	151	159
1	18	30	42	56	70	85	95	105–06	123	139	152	161
2	19	31	43	57	73	86	97	107	125	140	153	163
3	20	32	44	59	74L	87	98T	108–09	127	141	154	165
4–5	21	33–34	45	61	74R	88–89	98B	112	128	143	155	IBC
6–7	22	35	46–47	63	75	90L	99	113	129	145	156TL	OBC
8–9	23	36	48	64	76T	90R	100T	114	131	146	156TR	
10	24	37	49	66L	77	91	101L	115	132	147	157L	
11	25	38	50	66R	78	92L	101R	117	133	148	157R	
12–13	26–27	39	51	67	80	92TR	102L	119	134	149	158TL	
14–15	28	40	53	68R	81	93	102R	121	135	150	158TR	

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3	20	32	44	59	74L	87	98T	108–09	127	141	154	185
4–5	21	33–34	45	61	74R	89–89	98B	112	128	143	155	IBC
6–7	22	35	46–47	63	75	90L	99	113	129	145	156TL	OBC
8–9	23	36	48	64	76T	90R	100T	114	131	146	156TR	
10	24	37	49	66L	77	91	101L	115	132	147	157L	
11	25	38	50	66R	78	92L	101R	117	133	148	157R	
12–13	26–27	39	51	67	80	92TR	102L	119	134	149	158TL	
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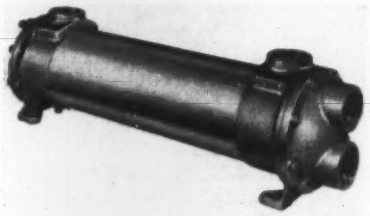
KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Heat Exchanger

Whitlock Mfg. Co., West Hartford, Conn., has announced a new line of Hi-Transfer exchangers available in a range of standard sizes and designed to offer high performance at low cost.

The new exchangers are designed to assure maximum heat transfer with minimum pressure drop. Shell and tubes are made for working pressures of 75 lb and are tested at 115 lb. All parts and exchanger units are interchangeable.

According to the company, bronze bonnets and tube sheets, seamless copper shells, Admiralty tubes, and brass baffles provide corrosion resistance. Zinc anodes are also available when required for specific applications.

Blind Fastener

A new rivet type fastener of hardened alloy steel for blind application is now available from Huck Mfg. Co., 2480 Bellevue Ave., Detroit 7, Mich.

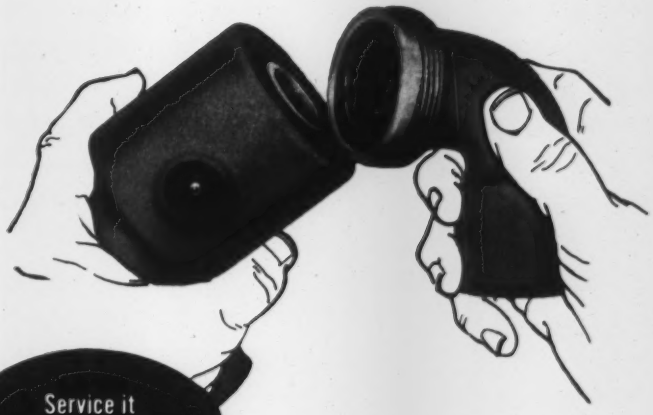
Designated the Tau Bolt fastener, the new device is $\frac{1}{4}$ in. in diam. It is available in a variety of grip lengths with either countersunk or brazier head. Positive mechanical lock, high shear strength and high tensile preload are among the outstanding features cited by the company.

According to the firm, pins break flush with the collar when the fastener is driven, and shank dimensions are held to unusually close tolerances to permit interference fit fastening designs. It is a four-piece design, consisting of pin, expansion sleeve, filler sleeve, and locking collar. The solid steel collar is designed to lock the pin permanently in position. Pin and filler sleeve are fabricated of accurately heat-treated alloy steel to provide maximum shear resistance.

The firm says the fastener is driven with a standard pneumatic or hydraulic tool, and is automatically and uniformly installed, resulting in absolute sheet pull-together. High tensile strength is said to be assured by the expansion sleeve design and positive mechanical lock. High tensile preload is claimed to be inherent in the installed fastener because installed force is double the rated strength.

Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS

Why CONTINENTAL-EMSCO
SWIVEL JOINTS
save you money!



Service it without removing from the line

No expensive return to factory for repair

Longer life...

THE CONTINENTAL-EMSCO SWIVEL JOINT BREAKS LIKE A UNION

Within a few minutes you can inspect and service Continental-Emsco Ball Bearing Swivel Joints. Simply break the joint as you would a pipe union. Packing is then readily accessible and easily replaced if necessary. This is vitally important to the field man and reduces maintenance costs. With Continental-Emsco you can count on free easy turning and years of economical service life.

Continental-Emsco Swivel Joints are manufactured in all popular sizes for practically every type of service; from high vacuum to pressures of 15,000 psi, and from sub-zero temperatures to 750°F. Simply tell us your application and type of end connections required. When you buy a Swivel Joint, specify CONTINENTAL-EMSCO.

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Serving the Oil and Gas Industries ... Worldwide

CONTINENTAL-EMSCO COMPANY

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Export Representative, R. J. Eicke & Associates, Inc.
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S-401

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Hydraulic Press

American Steel Foundries, Elmes Engineering Div., 1150-B Tennessee Ave., Cincinnati 29, Ohio, has announced a new and improved angle-type powdered metal forming press. Capacity of the main ram is 1000 tons, side ram 750 tons.

According to the company, extra heavy and rigid all-steel box type construction minimizes deflection. Independent hand lever control is provided for each ram, with a mechanical interlock preventing movement of main ram until a predetermined tonnage is reached on the side ram.

Remote control valves, manually operated, permit variation of tonnage applied to either ram, the firm reports. Die area is faced with hardened steel wear plates which are reversible.

The company says working area is readily accessible from either the front or rear of the press. Proportioning type of control on both rams is designed to permit easy set up of dies, and interlocked control is removed during die set-up. During regular operation the interlock is locked into place, thus preventing any possible damage to dies due to malfunction, the firm states.

Both main and side rams have rapid approach speeds, with slower speeds for pressing and a rapid return speed. The press is available in a variety of die spaces and tonnages. A third or bottom pressing cylinder can also be provided as an optional addition.

Fiberglass Ductwork

New, lightweight, chemical resistant ductwork made of fiberglass reinforced plastic is announced by Molded Fiber Glass Sheet Co., Ashtabula, Ohio.

The new ductwork was designed by Industrial Rayon Corporation's engineers for exhausting vapors from the spinning rooms at the company's Cleveland and Painesville plants. There it replaced corrosion resistant metal ducts previously used for this purpose, at approximately 25 per cent less cost, according to the manufacturer.

Balanced Valves

Granberg Corp., 1308-67th St., Oakland 8, Calif., announces the addition of a new 10-in. balanced valve with hydraulically balanced closing action that protects the entire system by eliminating the slamming effects of line-shock upon closing.

It can be furnished with pre-control and linage so that the valve automatically shuts off when the pre-determined gallonage has registered through the meter, the firm states. The valve can also be used as a control valve, where case of opening, soft closing and positive shut off is required. It is adaptable to remote operation by air, hydraulics or electrical means.

The new valve closes in two stages. Its first motion is described as a gradual, smooth shut-down from full open to an almost seated position. The final closing stage is said to be gentle and without shock.

WHEN THE BOTTOM DROPPED OUT of the ERIE CANAL

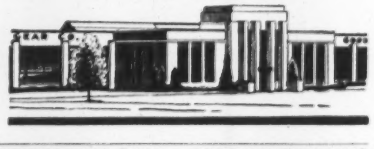
Of the many noteworthy events that took place back in 1907, one of the most unusual occurred near Syracuse New York, where a part of the bottom of the Erie Canal dropped out. Four canal boats were sucked through and shattered; a flour mill was badly damaged; and there was a loss of over $500,000. This catastrophe may sound more believable when we tell you that the break occurred on a viaduct over Onondaga Creek.

In a more constructive vein, a happier (if less publicized) event occurred in Cincinnati in the same year, when Soren Sorensen and John Christensen founded what was to become The Cincinnati Gear Company.

In the ensuing fifty years, many changes have taken place. People no longer ride on canal boats; and the gear-manufacturing business has progressed similarly. Technologically we've been in the forefront of this progress, but we've also tried to preserve some of the attention to detail and "craftsmanship" that prevailed in those earlier times. The result has been a gratifying record of customer satisfaction — the kind of satisfaction we'd like *you* to experience on your next custom gear order.

THE CINCINNATI GEAR CO.
CINCINNATI 27, OHIO
Fifty Years of "Gears—Good Gears Only"

CINTI ®



KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Skew Loading Unit

Equipment for the automatic skew loading of gears prior to heat treating has been announced by Gear-O-Mation Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Using the unit, an operator can load 4200 face-oriented gears per hour on to a gear carrier, the firm reports. Although designed expressly for high volume gear heat-treating operations, the skew loader is said to be applicable to many other center-bored parts and production methods.

In operation, the gears enter the skew loader through a gravity expandable track and are stopped by an escapement mechanism. From the escapement, gears are fed one at a time into a V-track and are pushed forward by the plunger of an air cylinder actuated by a proximity switch. The air cylinder, returning to neutral, triggers a limit switch-controlled solenoid which releases another gear. This action takes place in split seconds—an average skew load of about 14 gears is readied in less than 5 seconds.

When a full load is positioned, the operator inserts the skew (or rod) through the center-bored holes and lifts the load on to a gear carrier. Operator action is almost continuous at the loader's high speed, the company says.

High Pressure Hose

A line of Surgepruf medium-high and high pressure hydraulic hose and hose couplings which feature the firm's double-wedge grip, said to eliminate the need for skiving rubber covered wire braid hose, has been introduced by Alemite Div., Stewart-Warner Corp., 1826 Diversey Pkwy., Chicago 14, Ill.

The couplings, which the company says may be used over and over again, bite through the rubber cover, grip solidly on either single or double wire braid hose without weakening the protective cover nor the water-proofing qualitites of the hose.

This non-skive feature saves time and labor, and provides a hose connection that is always at full "metal-to-metal" strength, the company claims.

To assemble the couplings it is not necessary to use a mandrel to flare out the hose in the socket. Since the insert and the end of the hose are both exposed before the socket is engaged to the bushing, the insert can be rolled into the hose without a possibility of gouging as with conventional couplings, the company states.

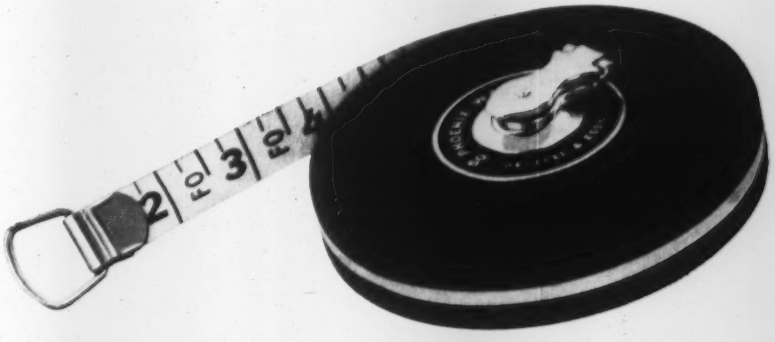
The hose, constructed of seamless inner tube of synthetic rubber reinforced by a single steel braid for medium-high pressure, and two layers of steel wire braid separated by a layer of synthetic rubber for high pressure systems, has an operating temperature range of −40 to +275 F, and a burst range of from 1400 to 18,000 psi. The rubber covered hose is also resistant to oil and weather, the company says.

ALBADURE*... the steel tape with lasting legibility

Here is a steel tape that stays clear and legible long after markings on other tapes have worn off.

An amazingly tough plastic coating on both sides of the line protects the white background, the graduations and numbers on ALBADURE tapes, giving their surfaces tremendous resistance to abrasion and corrosion. To quote a State surveying party report, "If ALBADURE stood up in this tough mud and sand, it'll stand up anywhere." Available in all standard lengths, widths and graduations, in cases and on reels.

PHOENIX WYTEFACE®... the woven tape that outlasts others 3-1



PHOENIX WYTEFACE (non-metallic) Woven Tapes made from extra strong synthetic yarns, are harder wearing, with higher tensile strength and dimensional stability than ordinary woven tapes. A special plastic coating on both sides protects the line against hard use, water, stones or brush.

The end of the line is enormously strengthened by a lamination of Flexi-Foam, a spongy plastic-rubber. No stitches or hinge point to weaken the line.

A Highway Engineer reported of the non-metallic PHOENIX WYTEFACE, "It has at least three times the life of an ordinary metallic tape." *Ask Your K & E Dealer!*

*Trade Mark

89 YEARS OF LEADERSHIP In equipment and materials for drafting, surveying, reproduction and optical tooling . . . in slide rules and measuring tapes.

KEUFFEL & ESSER CO.

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Type A centrifugal basic pump. Suction and discharge in lower half of casing.

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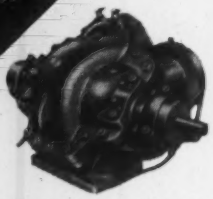

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Miniaturized Locking Inserts

A miniaturized series of self-locking wire thread inserts has been introduced by the Heli-Coil Corp., Danbury, Conn.

The new 4-40 Screw-Lock series was designed to reduce the space and weight limitations of handling fastener problems on electronic, automotive, aviation, machine tool and instrument assemblies.

The series is said to eliminate the need for lock washers, lock nuts and locking wires with an integral gripping coil. The locking effect remains through repeated cycles of disassembly and a locked screw may be readily freed by applying break-away torque approximately the same as used in the original assembly, the company states.

Stop Clock

A electrical stop clock featuring instantaneous electrical reset ($^1/_{10}$ sec) and accuracy of .02 of 1 per cent, has been announced by Cramer Controls Corp., Centerbrook, Conn.

Designated Type 691 time totalizer, a dust-tight commercial model and a military version are offered. According to the company, the military unit is hermetically sealed and designed to meet stringent vibration, shock and environmental specs.

Type 691 is available for either local or remote reset. Where local reset is desired, a pushbutton is provided on bezel. On the sealed timer, pushbutton actuates reset solenoid through a bellows.

Load switches rates 5 a to 250 vac resistive, operated from cams on either fast or slow pointer shafts, can be supplied. Number of pulses per second or minute, and duration of pulses are factory set. With switches on both fast and slow pointer shafts (wired in series) it is possible to use the 691 as a highly precise time delay or interval timer, the firm states.

Available ranges are 60 sec in $^1/_{100}$ sec, 60 min in $^1/_{100}$ min, and 60 min in sec. Ratings include all standard voltages at 50 and 60 cycles, 115 v 400 cycles (with d-c, clutch) and various d-c voltages.

Gas Unit Heaters

A pair of 300,000 Btu models, said to be the largest suspended gas unit heaters ever offered as standard equipment, are now being produced by the Reznor Mfg. Co., Mercer, Pa.

Models US300-F and US300-B, propeller fan and centrifugal blower powered respectively provide ample air movement for effective heat distribution at a minimum noise level by the use of two smaller fans or blowers in place of one extremely large one.

On the US300-F, two 15-in. fans are driven by a single $^1/_3$ hp motor. On the US300-B, each blower has its own $^1/_3$ hp motor.

Overall dimensions of the new heaters are $33^1/_2$ in. high, 36 in. wide and $40^1/_4$ in. deep on the US300-F and $39^1/_4$ in. deep on the US300-B.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Double-Acting Thrust Bearing

Rollway Bearing Co., 541 Seymour St., Syracuse, N. Y., has announced a special double-acting thrust bearing, designed to withstand extremely heavy thrust loads from either direction. The flat-seat type bearing, with 2-in. bore and 6 3/16-in. OD, consists of center plate, two roller assemblies, two stationary plates, and two rotating inner sleeves. Plates, 7/8 in. thick, are held to extremely close parallelism to maintain maximum linear contact, the company explains. Inner sleeves and center plate are keyed to pinion shaft. Stationary plates are ground on OD for slip fit in the housing, with bores designed to provide proper clearance around inner sleeves.

Machined bronze retainers contain four 1/2 in.-diam rollers in each of sixteen slots. Three rollers are 1/2 in. long; the fourth, 3/4 in. in length, is staggered to equalize distribution of wear. Thrust capacity of DT-Type bearing is 17,550 lb at 750 rpm.

Right hand end of inner sleeve is extended and heightened to contact rotating inner race of radial bearing. The Type ML radial roller bearing, with sixteen 5/8 × 5/8 in. crowned rollers, has double-flanged inner race, single-flange separable outer race. Radial capacity, at 750 rpm, is 6300 lb.

Type MCS radial bearing on input shaft is similar in construction and capacity to Type ML, except that separable outer race is straight.

Threadless Fittings

Threadless pipe fittings designed to withstand traction forces up to 3600 lb and hydrostatic pressures ranging from 450 psi on 2 in. pipe to 5000 psi on 1/2 in. pipe have been developed by Telsco Fittings Div., 5422 Redfield St., Dallas, Tex.

Fittings are factory assembled for use in joining steel, wrought iron, or plastic pipe. They do not require threading, grooving, flaring, soldering or welding, the company states.

According to the firm, superior gripping action is achieved through a specially designed brass clutch ring with internal serrations which grip the pipe wall as the fitting nut is tightened. At the same time, a neoprene gasket is compressed against the pipe wall. Socket ends and nuts are reamed slightly oversized to accommodate out-of-round and off-tolerance pipe ends.

The fittings are available in couplings, adapters, 90-deg. elbows and tees. Applications cited by the company include prime plumbing work, plumbing repairs, cuts into existing lines, oil and gas piping and machinery and equipment lines.

The fittings are made from high-tensile, corrosion-resistant malleable iron to ASTM specifications. They are available in galvanized or Parkerized rust-proof finish. Machines-brass stiffeners are available as accessory equipment for joining plastic pipe and tube.

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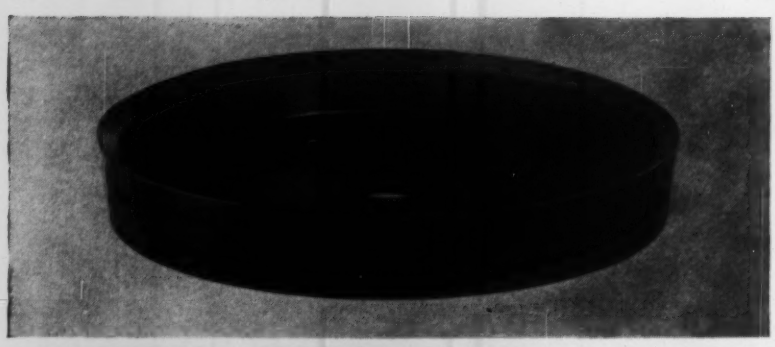

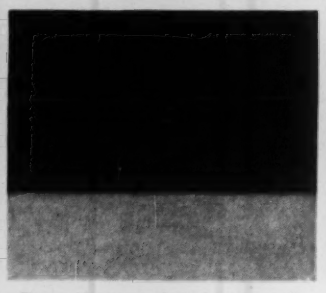

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Displacement Pump

A 6-in. Granco rotary positive displacement flanged pump is now being manufactured by Granberg Corp., 1308—67th St., Oakland, Calif. This new model handles capacities up to 225 gpm for hot asphalts, and up to 350 gpm for gasolines and fuel oils.

The model HG pump can be powered by gasoline engine or by other power. The pumping principle of design is the universal-joint rotary action that is used on the firm's line of rotary positive displacement pumps.

The pump is available in steel or cast iron construction. The steel models are for hot asphalts and other viscous products and will operate at temperatures up to 600 F, the company says, and cast iron models are for gasolines and other lighter products. Both models operate at pressures up to 70 psi.

Pressure Regulator

Design of an improved pressure regulator has been announced by Davis Regulator Co., 2538 So. Washtenaw, Chicago 8, Ill.

The new regulating valve incorporates a larger through passage which gives a greater capacity and also a less turbulent flow pattern through the valve, the firm states.

The construction of the valve is said to be simple—the valve disks are interchangeable so the user can switch from water service, for example, to steam, gas or air. This is accomplished by removing one disk and substituting a disk for the service desired. There is also an added safety factor because the spring adjustment is made from below rather than from above as in previous models, the company reports.

Reduced pressure range is from 1 to 100 psi, depending on the size of the valve, with initial pressures as high as 400 psi. The unit features a built in strainer. The valve is made in bronze, semi-steel, or steel body with special alloy trim available if desired. Standard sizes are $^3/_8$, $^1/_2$, $^3/_4$, 1, $1^1/_4$ and 2 in.

Grip Ring Assembly Tool

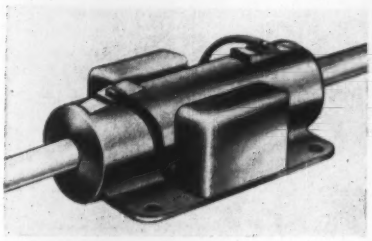
A new assembly tool for the firm's Truarc Series 5555 grip rings which spreads the ring to the exact diameter required for installation, automatically preventing overspreading and subsequent permanent set, has been developed by Waldes Kohinoor, Inc., Long Island City, N. Y.

Known as the Model GR, the tool looks somewhat like a conventional hand pliers. Instead of plier tips, however, the front end consists of two hardened tool steel parts: a head with a nest for holding the ring and a wedge-shaped ring spreader.

To install a ring on a shaft the tool is used in the following manner: The ring is inserted by hand in the nest so that the ring opening is opposite the wedge. When the handles are compressed as far as possible the wedge enters the opening and spreads the ring to precisely the right diameter for installation. The

tool is then passed over the shaft until the ring is in the proper position. When the handles are released the ring springs closed so that it is locked in position on the shaft. The tool is then removed.

To remove the ring the procedure is reversed: The tool is placed over the shaft so that the ring is flush in the nest. The handles are compressed and, with the spread ring locked in the nest by the wedge, the tool is removed from the shaft. The handles are then released and the ring removed from the nest. The ring may be re-used after disassembly.



Ultrasonic Flowmeter

A new straight-through flowmeter, designed to achieve accurate flow rate measurements by the modification of an ultrasonic beam, has been announced by the Vibro-Ceramics Div., Gulton Industries, Inc., 212 Durham Ave., Metuchen, N.J.

Because this new instrument offers no obstructions to the fluid flow, pressure drop is eliminated, maintenance is simplified and greater accuracy is consistently attained, the company claims. It is adaptable to the measurement of such liquids as kerosene, liquid oxygen, water and similar low viscosity liquids, the firm states.

The unit is designated as Glennite Model UF-100. It will measure flow rates in the range of 1000-4000 gpm with an accuracy of better than 1 per cent, and provide 5 volts full scale output to feed into standard telemetering and recording systems, the company says.

Special instruments for the measurement of volumetric flow, and complete control systems designed around the flowmeter, can be provided.

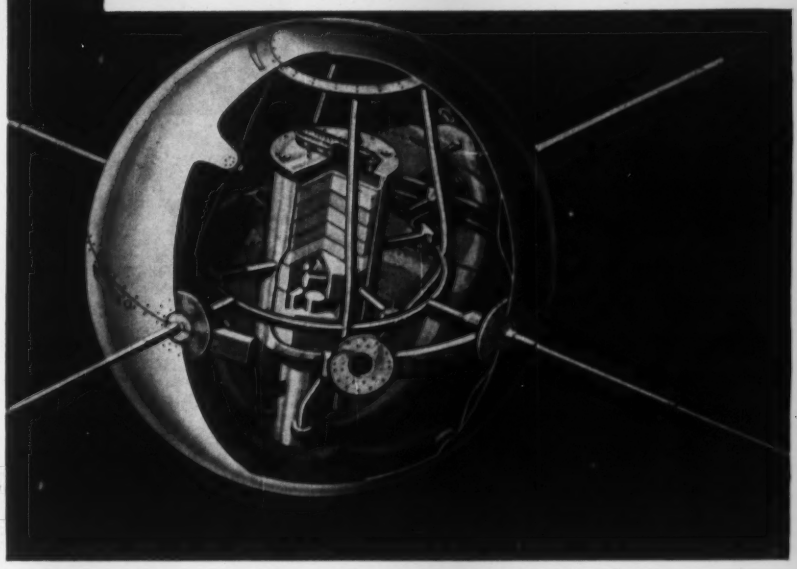
Coating Applicator

A new machine for applying Tarset, a coal tar-epoxy resin coating, to pipe interiors has been developed by the Protective Coatings Div., Pittsburgh Coke & Chemical Co., Pittsburgh.

The company's applicator is capable of laying a smooth film of the coating on the interior of 20-ft lengths of 3, 4 and 6-in. pipe. It achieved a 15 to 20-mil thickness in a single pass.

According to the firm, two novel features are incorporated in the construction of the applicator. First, the tar-epoxy blend and

ENGINEERS: *Electronic & Mechanical,* ***PHYSICISTS***



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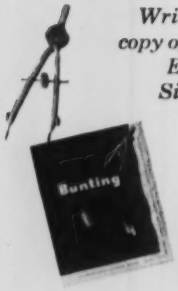

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

its catalyst are fed separately into the applicator in carefully controlled proportions. High speed mixer blades thoroughly blend the two components in the space of a few seconds. This eliminates the possibility of error and oversight as well as the problems of pot-life encountered in mixing large batches, the firm states.

Second, the mixed material is expelled from the mixing chamber under positive pressure into a spinning cylinder which centrifugally casts the material on the interior surfaces of the pipe. The company claims the applicator does away with curtaining or sagging, commonly found when heavy film thicknesses are applied in one coat.

Forged Steel Union

A new 6000 lb forged steel union is now available with special heavy duty walls for power piping at higher pressures and higher temperatures from Clayton Mark & Co., Evanston, Ill. The wall thicknesses of the new Petro unions, which are available in nine sizes, have been increased substantially. Comparing the conventional 3000 lb CWP union to the new union, the diameter of the hub ends of the 1/8 in. union has been increased from .625 in. to .780 in. and the 2 in. union has been increased from 2.850 in. in diam to 3.430 in.

The new union is rated 1500 lb steam working pressure at 900 F and is available both in threaded and socket weld types. The company says tension and torsional strength sufficient to withstand continuous stresses of high pressure piping systems are developed in the unions through its induction-heat forging process.

Both nuts and ends are octagon-shaped to provide flat gripping areas for wrenches. The nut threads are rust-proof, spark-proof and permanently lubricated with Cadmium to enable quick makes and breaks with a minimum of wrenching, the firm states. The ends are tapped, sharp and clean, to American Standard B 2-1 1945 (for tapered pipe threads).

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Rotary Feeder

A compact, periphery sealed, eight pocket rotary feed unit of the air lock type for feeding bulk chemicals and other materials into industrial processes at differential pressure to 25 psi has recently been developed by Beaumont Birch Co., 1505 Race St., Philadelphia, Pa.

According to the company, unique design features are the mating, V-shaped, floating, Teflon seal rings that extend service life four to six times over previous models and the outside adjusting screws that permit adjustment of floating seals for maintenance of a perfect seal without dismantling the feeder.

Adjustable tips on the rotor blades are available in nylon, Teflon, neoprene, rubber, stainless steel or monel. The firm says the tips can be adjusted for wear through a gasketed door without removing the rotor from the feeder. The unit, called the STT type, is available in 4, 6, 8 and 10 in. sizes combined with a new vari-speed motor-drive with ratios up to 10 to 1. Other types of constant or variable speed motors can be furnished.

Vibration Isolation

Lord Mfg. Co., 1635 W. 12th St., Erie, Pa., announces a new series of heavy-duty Temproof mountings for use on heavy electronic equipment.

The new mounting features load capacities above 60 lb, temperature resistance from −80 to 250 F, superior vibration isolation performance in severe operating conditions, the company states.

The mounting is designed to meet the specification requirements of MIL-C-172B and is self-damping in its resonant range. They support loads in either the upward or downward direction, the company reports.

Metal-Working Press

Federal Press Co., Elkhart, Ind., announces the addition of a new, large capacity press to its line of metal-working presses. Designated Model 55, the 56-ton unit is designed with oversize dimensions in order to accommodate larger dies.

According to the company, the press will economically handle laminations, trimming of die castings, and similar bulky operations which would otherwise tie up larger and more costly equipment.

Dimensions of the new 55 include a 4-in. stroke standard with up to 12 in. available at extra cost. Ram area: $11\frac{1}{4} \times 24$ in. standard; available up to $11\frac{1}{4} \times 36$ in. Shut height: $12\frac{1}{4}$ in. standard—up to additional 21 in. available with frame extension. Bed to slide, stroke down adjustment up: 15 in. Throat depth: 15 in. standard—also 17 in. available. Opening through back: 22 in. standard—also 26 in. available. Bolster plate: 36×28 in.

The model is available in either flywheel or geared type, in mechanical or air clutch models.

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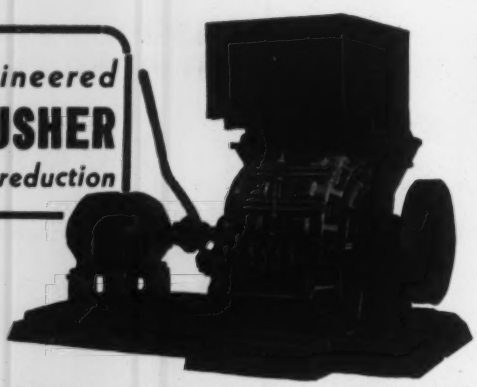

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Felt Tag Stock

American Felt Co., Glenville, Conn., has announced development of two new fiber bonded nonwoven felts, one of dacron windsor felt, the other of dynel windsor felt with an eggshell finish, for use as tag stocks in special applications.

The two tag stocks, said by the company to be characterized by high strength, stability to chemical and biological attack and ease of printing, will supplement the present lines of tag producers. The firm says the new stock does not tear and no special printing techniques are required, and the tags can also be used for permanent records, diplomas and parchment substitutes. The new tag stock comes in .009-in. thickness, is 74-in. in width and weighs 6–7 oz.

Color Coat

A new color coat, No. 261, is available from Insul-Mastic Corp. of America, Dept. B-48, 7750 W., 61st Pl., Summit, Ill. The material is designed to stick to and cover black bituminous coatings, old or new, as well as concrete, brick, cinder block, porous roofing tile, asbestos shingles, stucco, and properly primed wood and metal. Dry time is approximately 30 min.

A modified acrylic resin dispersion combined with selected chemically inert pigments, the color coat leaves a tough pigmented plastic film that flexes with expansion and construction of base material, the company says. It is described as being especially suitable for color keying service lines. According to the firm, the new color coat shows remarkable resistance to sunlight, gases, corrosive fumes, cleaning compounds and many solvents. It is available in rose, light green, light blue, light yellow, light buff, light gray, dark gray, and white.

Hydraulic Exciter

A hydraulic vibration exciter said to be capable of sinusoidal motion at extremely high forces and large strokes not obtainable with present vibration test equipment is announced by MB Mfg., Co., Div., Textron Inc., New Haven, Conn.

The first system now being installed has a maximum force of 60,000 lb, an available stroke of 4 in., and a maximum velocity of 14 in-sec in the frequency range of 1 to 150 cps. The newer C250 electrodynamic exciter, the largest of that type now in production, has a rated force output of 25,000 lb and stroke of ± 0.25 in. in a frequency range from 5 to 500 cps.

The exciter has five basic components: the driving head, hydraulic accumulator and a high-pressure hydraulic pump, electronically controlled servo valve, and an electronic control system. Design of the hydraulic system is virtually identical for all exciter ratings, the limits of force, stroke and frequency depending on the capacities of the servo valve actuating cylinders and hydraulic pump, the company states.

KEEP INFORMED

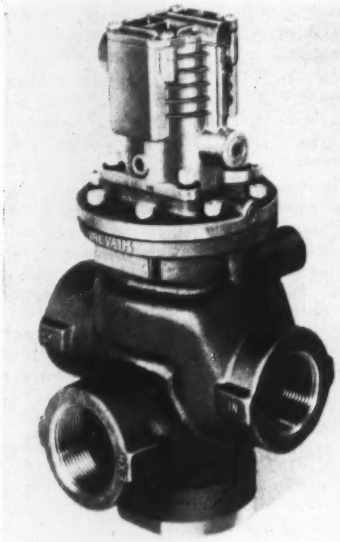
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Recording Gages

Recording gages for pressure, vacuum and water or liquid level measurements are now available in new weatherproof cases, according to an announcement by Bristol Co., Waterbury, Conn.

The new gages are designed for wall or pole mounting outdoors, where it will be subjected to all types of weather. Measurements of water depths or other liquids can be accomplished with float-type, pressure-type, differential-pressure-type, or bubbler-type liquid level gages; pressure gages are offered in all ranges.

Both 8- and 12-in. round chart models are available in the new cases; flowmeters and thermometers are also offered.



Control Valves

Valvair Corp., 454 Morgan Ave., Akron 11, Ohio, announces a series of high flow capacity instant-action poppet-type control valves, designed for use on large brake, clutch and other devices, especially on high speed applications.

Said to provide almost instantaneous response due to extremely short poppet travel, the new 2- and 3-way valves are designated Valvair Hi-Speed Inlines. This response provides shorter machine cycle time and results in increased work output, says the manufacturer. Other advantages are claimed to include more accurate cuts on high speed cutoffs, less brake and clutch slip with decreased maintenance costs and minimum downtime, faster machine set-up and improved operating safety because of minimum machine drift and over-travel.

The valves, said to be simple in design and construction, have only three moving parts. The air-cushioned poppet is operated by a standard PC solenoid pilot. Cast Navy M

To the engineer with a bent for research...

WHIRLING WET AIR with tornado speed, AiResearch water separator wrings it dry... makes sure no vapor enters aircraft cabin from the air conditioning system.

The Garrett Corporation operates under the principle that the units and systems which we research, design and produce must be the best of their kind.

That's why we need forward-looking engineers. Stimulating assignments in the work you like best are only part of what we offer. We pay a premium for ability. You'll work with the finest research and laboratory facilities at your disposal... live in the most desirable areas in America — California, Arizona, the East Coast.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer equipment, electro-mechanical equipment, electronic computors and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley

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9851 S. SEPULVEDA BLVD., LOS ANGELES 45, CALIFORNIA

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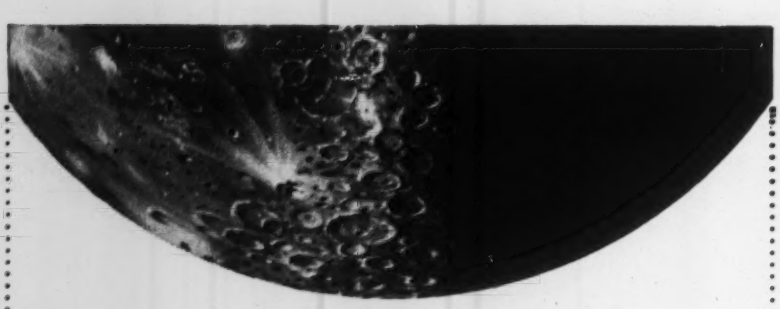
AIRSUPPLY • AIR CRUISERS • AIRESEARCH AVIATION SERVICE



We have important jobs in Large Rocket Engineering for men with a flair for

MATHEMATICS

If you had a strong math record in college—and if you have a curious, probing, exploring sort of mind—you'll probably qualify for one of the jobs now open in our Systems Analysis Group.

This group begins work on each new rocket-engineering project as soon as it reaches the preliminary-design stage . . . analyzes environment, thermodynamics, fluid flow, performance, and reliability . . . follows the project straight through to final testing.

We can use almost every kind and level of mathematical ability . . . backgrounds ranging from the broad and analytical to specialization in statistical methods, numerical techniques, and computer programming (advanced degrees welcome but not essential for some jobs).

We'd like to talk to engineers—mechanical, electrical, aeronautical, chemical—and to physicists with M.S. and Ph.D. degrees. We're interested in men with experience in the mathematics of power plants (jet, steam, gas turbine), chemical processes, petroleum refining, aviation, missiles, and flight analysis.

There's never a humdrum minute in our Systems Analysis Group. Each day brings challenging new problems to solve. You'll have every opportunity to increase your professional stature. Free, on-the-job courses of graduate level are offered in rocket theory and computer programming (Rocketdyne has the most advanced digital and analog computers). And you'll be a key man on the team that is designing, developing, and building the large liquid-propellant rocket engines for America's major missiles.

Please tell us about yourself—with emphasis on your technical background. Write: A. W. Jamieson, Rocketdyne Engineering Personnel Dept. ME-61, 6633 Canoga Avenue, Canoga Park, Calif.

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

BUILDERS OF POWER FOR OUTER SPACE

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

bronze valve bodies, stainless steel moving parts and Hycar sealing materials are reputed to afford exceptional resistance to corrosion.

The valves are offered with integral pilots or for remote pilot operation, in both 2- and 3-way types, NO or NC. Working pressures range from 10 to 200 psi; in 1, $1^1/_4$ and $1^1/_2$ in. NPT sizes. Solenoid pilot coils for ac or dc, any voltage, are available. The valves are also offered in $^1/_4$ to 1 in. NPT sizes, with standard Speed King solenoid pilots, built to JIC standards.

Variable Speed Motors

A modification of the Varidyne system, recently developed by U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Calif., is designed to now permit soft starts, inching and jogging of a remote, variable speed, a-c induction motor.

The system is said to be suitable for web drives and other applications requiring adjustable acceleration, and offers control of the drive motor starting torque from 50 to 150 per cent.

The system consists of a power unit (constant speed a-c motor, variable speed transmission and alternator), an exciter unit with tap transformer for control of starting torque and one or more motors of the a-c induction type. According to the company, the motors change speeds equally and simultaneously in response to the variable frequency output of the power unit and are available in open, totally-enclosed and explosion-proof designs, with or without internal gearing.

Oil Hole Drills

Whitman & Barnes, 40600 Plymouth Rd., Plymouth, Mich., announces a complete line of high speed oil hole drills.

Designed for use on production runs in screw machines or turret lathes, these drills feature continuous holes drilled through the body and shank of the tool. This, the company says, permits lubricant or air to pass freely to the drill point where it acts as a coolant, as well as a force to eject chips and dirt. Another feature cited by the firm is that the continuous oil holes may be easily cleared and cleaned if blocked by foreign matter in the coolant.

The oil hole drills are regularly stocked in straight shank taper length sizes from $^7/_{16}$ to $1^1/_2$ in. by 64ths. Shank ends are tapped for use with threaded pipe connections or can be made to fit special requirements. Taper shank, extra length and larger diameter oil hole drills can also be furnished.

For Consulting Engineers
Turn to Page 182

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
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Position Indicator/Controller

Operation and position-indication of remotely located valves, gates, feeders, or other devices is said to be possible with new Synchro-Scan position indicator/controller units recently developed by Builders-Providence, Inc. Div., B-I-F Industries, Inc., 345 Harris Ave., Providence, R. I.

According to the company, the units permit the remote modulation and continuous indication of valves of similar devices. This is accomplished through the transmitter package (a plug-in unit) which has a three-position (open, close, and off) switch mounted on its face to control the device. Above this switch is a small voltmeter-type indicator graduated from 0 to 100 per cent to indicate the per cent of opening.

At the receiving end, another packaged unit contains the control relays and the regulated d-c voltage supply used to transmit the position indication. A standard electric position-transmitter is used to originate this voltage. Only two wires and a ground are required for transmission of the signal.

Lightweight Check Valve

A new aluminum check valve that weighs 4 oz has been added to the line of equipment products offered by Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich.

The firm says the valve is simply constructed, with a poppet the only moving part. It is available in two models, $^1/_2$ and $^3/_8$-in. pipe size, and has a differential cracking pressure of 1 psi maximum. Differential sealing pressure is lets than 1 psi.

The unit withstands operating pressures of up to 125 psig and temperatures up to 175 F, the company states.

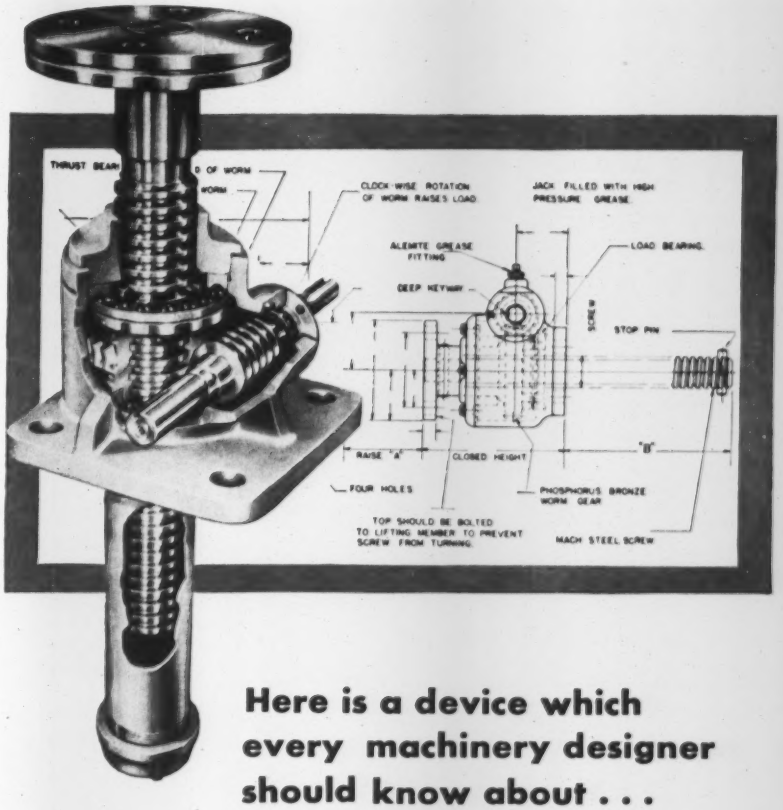
Low Capacity Pump

Sigmamotor, Inc., 52 N. Main St., Middleport, N. Y., announces the Model T-8 pump which utilizes the principle of moving steel fingers in a wave-like motion over flexible tubing, to pump liquids, gases and slurries.

According to the company, this principle eliminates any possibility of contamination of the liquid being pumped, or any danger of corrosion to the pump, due to corrosive characteristics of the liquid, because liquids being pumped never come in contact with any part of the pump mechanism.

The pump accommodates tubes of $^1/_4$, $^3/_{16}$, $^1/_8$, $^1/_{16}$ in. ID by $^1/_{16}$ in. wall, and $^1/_{32}$ in. ID by $^1/_{32}$ in. wall. It can be used with gum rubber, silicone rubber, surgical gum latex, neoprene or polyvinyl tubes.

Capacity range of unit is .1 cc per min to 250 cc per min. The standard unit includes a Model 14 Revco Zero-Max speed changer and a $^1/_{12}$ hp, open motor with switch, all mounted on an aluminum base. Special motors are available.



Here is a device which every machinery designer should know about . . .

DUFF-NORTON WORM GEAR JACKS

Duff-Norton worm gear jacks provide a purely mechanical means for accurate positioning of loads weighing as much as several hundred tons and maintaining them indefinitely without creep. They will operate in any position, and functioning as components of machinery and equipment they can raise and lower loads, apply pressure or resist impact. Jack capacities range from five to 50 tons. When two or more jacks are connected by means of shafting and mitre gear boxes they lift in unison, even when the load is unevenly distributed. They are available with standard raises up to 25 inches, and will provide exactly the same raise for years without adjustment. Worm gear jacks are suitable for operation at ambient temperatures up to 200°F.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, arbor presses, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting bulletin AD-34-FF, which includes drawings and full specifications.

DUFF-NORTON **Duff-Norton Jacks**

DUFF-NORTON COMPANY
P. O. Box 1889 • Pittsburgh 30, Pennsylvania
COFFING HOIST DIVISION: Danville, Illinois

Ratchet Jacks, Screw Jacks, Hydraulic Jacks, Special Worm Gear Jacks, Ratchet Hoists, Electric Hoists, Load Binders, Spur Gear Hoists

ROCKFORD

CLUTCH PORTS HELP

HEAT & DIRT ESCAPE

Small Spring Loaded

Automotive Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

Light Over Center

Power Take-Offs

Speed Reducers

Nine large ports in the sides and twenty-one holes in the top of this ROCKFORD Spring-Loaded CLUTCH cover provide increased ventilation during operation under adverse conditions. Extreme heat, generated by modern high-speed engines, is dissipated—to prevent burning and warping. Dirt, grease and moisture, encountered in off-highway operations, are carried away —to avoid excessive clutch wear.

Learn how this and other recent improvements in ROCKFORD CLUTCHES will help *your* products meet changes in modern operating conditions.

SEND FOR THIS HANDY BULLETIN

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD Clutch Division BORG-WARNER

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ENGINEERING B-W PRODUCTION

CLUTCHES

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Aluminum Jackets

Aluminum Ell-jackets are announced by Childers Mfg. Co., Houston, Texas, as a new addition to its line of aluminum weatherproof jacketing for insulated lines, towers, vessels and tanks.

Ell-jackets are deep-drawn from .020 in. aluminum, No. 3003 alloy, to cover and protect insulated elbows. They are manufactured for both 90 and 45 deg ells and have factory-applied moisture barrier.

The new jackets are two-piece, precision-formed to fit snugly over the insulated elbow. Aluminum sheet metal screws are used to apply.

LATEST CATALOGS

Wire Rope Recommendations

A bulletin "Wire Rope Recommendations for General Contractors" has been prepared by Hazard Wire Rope Div., American Chain & Cable Co., Inc., Wilkes-Barre, Pa.

It describes the manufacturer's line of lay set preformed wire rope, wire rope accessories and Dualoc boom cable assemblies. The 16-page bulletin, designated DH-129-B, contains data on construction features, applications, diameters.

Palletless Handling

Yale & Towne Mfg. Co., 11,000 Roosevelt Blvd., Philadelphia 15, Pa., has published a bulletin on its Push-Pull loader with integral sideshift which is used for palletless handling.

In addition to complete specifications on the attachment which can be fitted to any Yale industrial lift truck, the bulletin pictorially describes the proper procedure for handling without pallets.

Hydraulic Power Units

A 52-page catalog on hydraulic power units, including pumps, cylinders, pressure switches and accessories, has been published by Oil-Dyne, Inc., 2117W W. Marquette Rd., Chicago 36, Ill.

The catalog contains technical data and specifications on 2240 different types and models of pumps, single and duplex pressure switches, hydraulic cylinders and such accessories as tube connectors, valves, hydraulic hose and fittings, tubing and gages.

Coupling Bulletin

A descriptive bulletin, No. 270 on its new quick-connect, quick-disconnect HK coupling is available from Snap-Tite, Inc., Union City, Pa.

The coupling is described as the first successful field-tested quick-connect coupling using Teflon seals throughout. It is designed for acids, alkalies, solvents and high pressure steam.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Nuclear Pump Welding

"Welding for Nuclear Pumping Applications," an 11-page illustrated report, is available from Byron Jackson Div., Borg-Warner Corp., Box 2017A, Terminal Annex, Los Angeles 54, Calif.

Welding requirements for nuclear service are outlined and 15 specific do's and don'ts for nuclear welding are prescribed. Photographs and drawings illustrate various nuclear pump welding designs and welding set-ups.

Induction System

A manual D-425B, outlining the proper method of balancing induction air conditioning systems is available from Trane Co., La Crosse, Wis.

Designed and developed for use in multi-room buildings, the system is said to be best suited to conditioning of perimeter areas of buildings. The system is designed to maintain comfort conditions the year around, regardless of variations in sun, artificial light or occupant load.

Car Pullers

Jones Machinery Div., Hewitt-Robins, Inc., 666 Glenbrook Rd., Stamford, Conn., has published a 32-page booklet on car pullers.

The booklet contains a description of several installations and describes various types of car pullers for moving freight cars, barges, scrap buggies, furnace cars and many types of industrial transfer cars.

Hammermills, Shredders

American Pulverizer Co., 1249 Macklind Ave., St. Louis 19, Mo., has published a new bulletin covering hammermills, shredders, and rolling ring crushers.

Crushers described in the bulletin are the firm's WC and WS series crushers, as well as several special purpose models. Dimensions of both series are included. The new bulletin also presents a comprehensive list of ceramics, minerals, chemicals and metals now being reduced by users of American crushers.

Industrial Gas Chromatograph

A four-page brochure, No. 802, describing the firm's Model 220 industrial gas chromatograph is available from Beckman Instruments, Inc., Fullerton, Calif.

The Model 220 is claimed to be one of the first instruments to bring the simplicity and dependability of gas chromatography to process instrumentation. It has been designed for the continuous, automatic analysis of process streams, using a unique sampling valve and timing system. Samples are automatically extracted from the stream at intervals of five minutes to a half hour and accurately analyzed for up to eight critical components. The results are presented as a bar graph on a standard strip recorder.

Continued on Page 90

Photographer Bernard Hoffman found even the free flow of CO_2 from a cake of dry ice is difficult to control.

Controlling Flow in Fluid Engineering

To tame and control flow accurately, you must relate it to pressure, volume, turbulence and other variables. That's when you can look to the engineering leadership of S. Morgan Smith.

Butterfly valves are a good example. For the majority of processing situations, a wide range of standard R-S Butterfly Valves are assembled from stock for fast shipment. But for special fluid control problems, one or more can be applied to solve your needs. Standard or special, all R-S Butterfly Valves give you uniform flow control through all positions in the normal regulating range. You get minimum turbulence and pressure drop, save on pumping power because of simplified design and streamlined vanes. Compact and light in weight, they give you quick regulation and tight closure.

To learn more about the complete SMS line of Rotovalves, Ball and Butterfly Valves, call on our nearest representative. For information on special engineering, write S. Morgan Smith Co., York, Pa.

S. MORGAN SMITH SMS HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

CONSOTROL* RECORDING

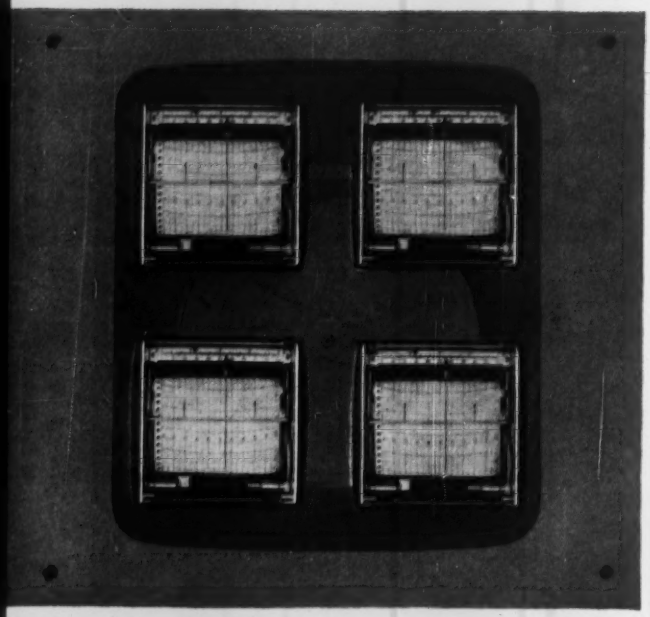


Illustration shows how 4 Consotrol Instruments require less panel space than does a single, conventional 12" recorder.

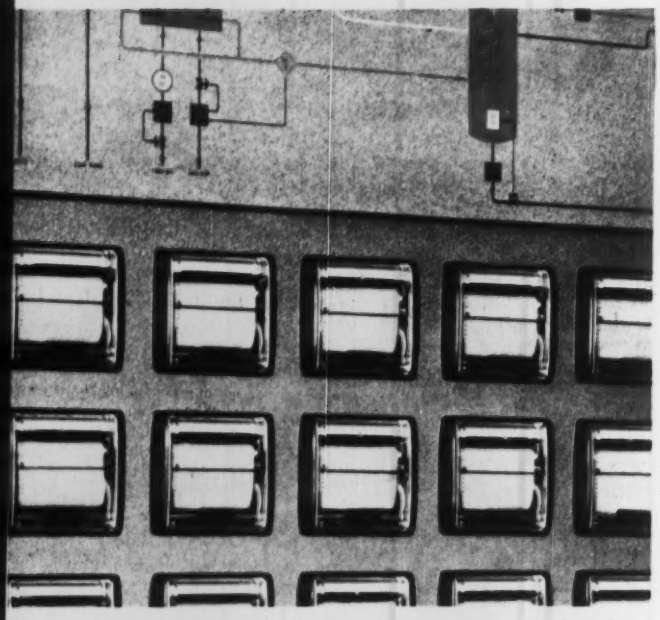
The ORIGINAL small-case control panel instrument with a FULL SCALE 4 INCH CHART...

Full-scale *readability!* Here is the industry standard set by Consotrol Instruments, with no compromise in compactness, convenience, or performance.

These Recorders and Recording Control Stations are so compact you can actually mount 4 in the space required by 1 standard 12-inch recorder. And yet, inside the case, all components are full size — nothing is "miniature."

With the integrally mounted Model 58 Controller, the Foxboro Consotrol Recording Control Station provides precise, dependable control and full-scale chart records in one-quarter the panel space. Maintenance is easier too, with all calibration adjustments made from the front . . . re-inking needed only twice a year . . . chart changes as seldom as once a month.

For the complete story, write for Bulletin 13-18. **The Foxboro Company, 966 Neponset Avenue, Foxboro, Massachusetts, U.S.A.**



Typical control panel showing Consotrol Recording Control Stations. Associated M/58 Controllers, integrally mounted, pull out with the recorders.

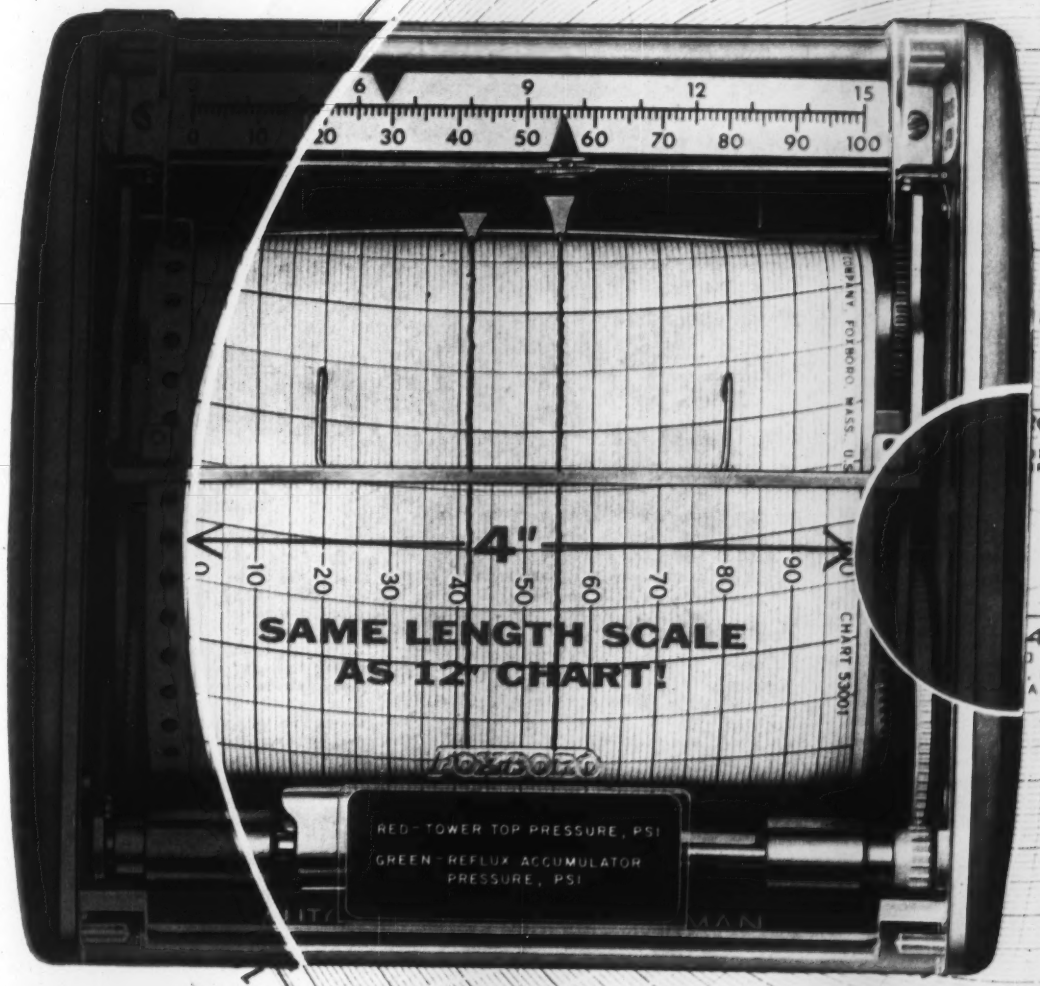
INTRODUCED IN 1952 — OVER 25,000 NOW IN USE

*Reg. U.S. Pat. Off.

FOXBORO

REG. U.S. PAT. OFF.

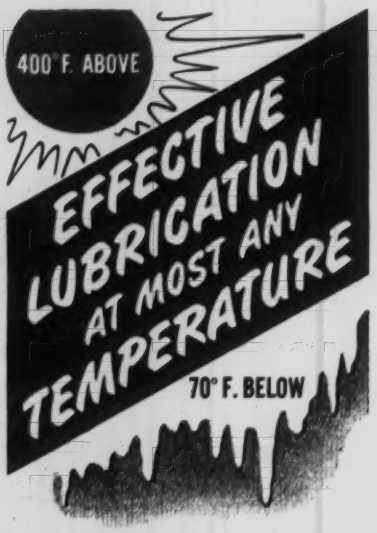
CONTROL STATION



ACTUAL SIZE illustration of Consotrol Instrument super-imposed on standard 12-inch chart. Note full 4" wide strip chart has same length scale as 12" circular chart.

CONSOTROL INSTRUMENTS

RECORDING · CONTROLLING · INDICATING



The fact that LUBRIPLATE Lubricants are able to meet extreme temperature conditions demonstrates the ability of these products to cope with the wide variations found in everyday industry. Besides this feature, LUBRIPLATE Lubricants possess attributes not found in conventional lubricants.

HIGH TEMPERATURES

LUBRIPLATE No. 930-AA.—Provides superior and protective lubrication for all types and sizes of machines operating at temperatures as high as 500°F. Possesses exceptionally high film strength and adhesiveness. Protects all metallic parts against rust and corrosion.

LOW TEMPERATURES

LOW-TEMP LUBRIPLATE—The outstanding multi-purpose grease type lubricant that will remain plastic at 70°F below Zero, yet has a Melting Point of 270°F. Resists water and acids—protects against rust and corrosion even from calcium chloride used on paved roads during winter months.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Write for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. LUBRIPLATE DIVISION, Fiske Brothers Refining Company, Newark 5, N. J. or Toledo 5, Ohio.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Stainless Plug Valves

A two-page bulletin describes a line of Teflon-sleeved stainless steel plug valves available from the Continental Mfg. Co., 247 Park Ave., New York 17, N.Y.

The bulletin features a cutaway view of a typical valve, which exposes the valve's unusual internal ribbed construction and clearly details other design points. Leakproof, positive shut-off is achieved without lubricated packing, the firm states. Components are labelled as to function and material used in construction.

Worm Gear Drives

A 16-page, illustrated brochure, No. 145, provides summary information on the standard line of speed reducers, worm gear sets and special units nanufactured by Cleveland Worm & Gear Co., 3249 E. 80th St., Cleveland 4, Ohio.

Thermistor Applications

A 10-page bulletin, No. T-100 on Glennite thermistors is announced by Thermistor Div., Gulton Industries, Inc., Metuchen, N. J.

It lists typical applications and circuitry and gives specifications and characteristics of wafer, rod, and bead thermistors. Each type of thermistor is illustrated with diagrams and charts indicating models and their corresponding characteristics and size. Included is a table showing the resistance ratio versus temperature to compute thermistor resistance at specified temperatures.

Tube-Expander Control

Bulletin 56-1, published by Thomas C. Wilson, Inc., 21-11 44th Ave., Long Island City, N. Y. describes the Model C Torq-Air-Matic, an air-powered boiler-tube expander drive and control.

The advantages of precise tube rolling are discussed and the features of the new device enumerated.

Instruments, Controls

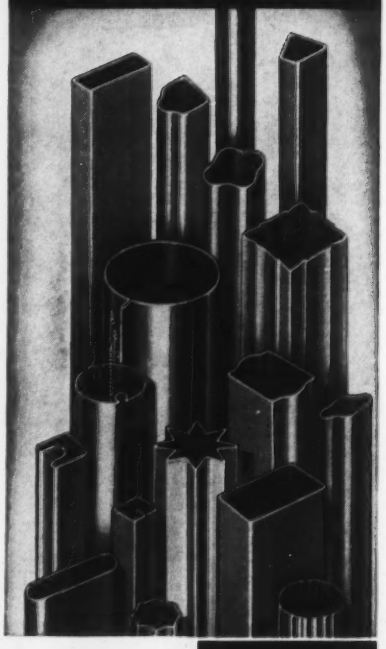
A digest of specifications of instruments and controls is offered in their new 12-page condensed catalog; Publication 57-687-297, from Hays Corp., Michigan City, Ind.

Engineering Aids

A series of engineering aids have been developed especially for engineers in the electronic and allied industries involved in the design, development, production or application of semi-conductors has been announced by Anchor Metal Co., 966 Meeker Ave., Brooklyn 22, N. Y.

Included is a periodic chart of the elements, with a chart of physical properties of pure elements used in semi-conductor production. There is also a complete list of all metals and alloys used in semi-conductors plus equilibrium phase diagrams for ten of the more popular doped alloys. All of the listed metals and alloys are available in solder microforms as disks, pellets, washers, wire, ribbon, sheets and spheres.

COLD ROLL FORMING TUBULAR SHAPES



Among the wide variety of things you can make on a Yoder Cold Roll Forming machine are round, square, oval, rectangular and other tubular shapes, such as illustrated. The seams may be open, lapped, butted, dovetailed, interlocking, etc.—as shown in the drawing.

Millions of feet of such unwelded tubular shapes are made from coiled strip for conductor pipe, bedsteads, lamp stands, window channel, wiring raceways, carrying rods, etc. Production ranges from 20,000 to 50,000 feet per day, with only one operator and a helper.

Yoder offers you the cooperation of their engineering staff for designing and adapting their cold roll forming machines, auxiliaries, and tooling, for the low cost production of structurals, mouldings and trim, panels, tubular and other shapes, to meet individual needs.

The Yoder Book on Cold Roll Forming is a complete, illustrated text on the art and the equipment needed for performing a variety of operations which can be combined with cold roll forming, at little or no extra labor cost. A copy is yours for the asking.

THE YODER COMPANY
5499 Walworth Ave. Cleveland 2, Ohio

YODER COLD-ROLL FORMING MACHINES

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Machining Stainless Steels

A pocket-size slide chart on machining stainless steels is now available from Carpenter Steel Co., W. Bern St., Reading, Pa.

On one side it gives data on turning, drilling, tapping, threading, milling and reaming operations. It tabulates speeds and feeds, and gives special notes on drilling, tapping, lubrication and welding. The other side of the chart shows relative workability of stainless steels in a wide variety of operations including blanking, deep drawing, stamping, forging, heading, roll threading, welding.

V-Drives, Bushings

A 46-page catalog providing information on fractional horsepower V-drives, drive parts and accessories has been made available from Maurey Mfg. Corp., 2915 S. Wabash Ave., Chicago 16, Ill.

The book presents descriptions and size data on the firm's line of bushed type and fixed bore type cast iron and pressed steel V-pulleys, V-belts, refrigeration fans and fan pulleys, and V-drive accessories. A special page is devoted to interchangeable bushings.

Motors, Fans, Blowers

A 14-page catalog on its line of specialty motors, fans, and blowers has been released by Ashland Electric Products, Inc., 32-02 Queens Blvd., Long Island City 1, N. Y.

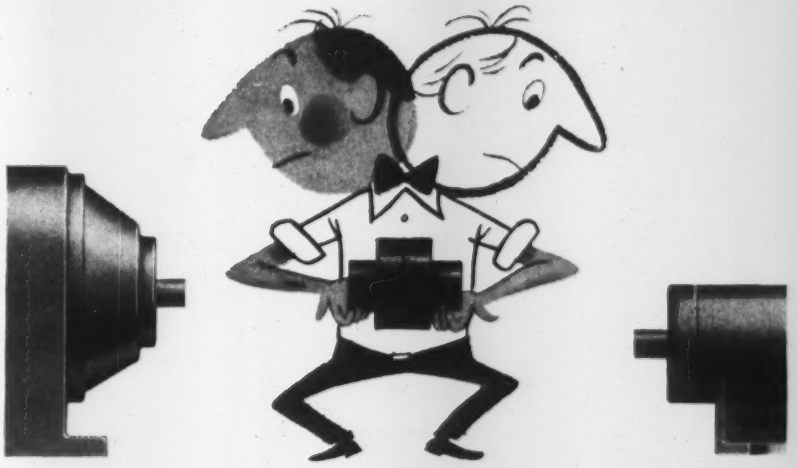
The catalog offers details, physical specifications, and electrical characteristics on synchronous, torque, induction and gear motors, centrifugal blowers and axial fans. Both standard and custom models are available for commercial or military applications.

Casters and Wheels

A caster and wheel Catalog No. C-57 has been published by Fairbanks Co., 393 Lafayette St., New York 3. Construction and benefit descriptions and full specifications are provided for the firm's line of industrial casters and wheels including patented Lockweld steel casters for regular and medium-heavy duty and new Lamilon all-plastic, nylon-reinforced wheels. Also included in the catalog are steel casters for heavy duty and trailer applications, semi-steel casters, vulcanized rubber tired wheels, solid rubber and pneumatic rubber tired wheels and semi-steel wheels.

UNITED COMMUNITY CAMPAIGNS
Give...the United way

why limit yourself to SHORT couplings?



there is an easy way to
couple machines 1 to 50 feet apart

Watson-Spicer Flexible Shafts can transmit from 10 to 800 horsepower either horizontally or vertically. Putting extra distance between driving and driven machines allows you to solve many problems – elbow room for maintenance – better weight distribution – flexibility of space allocation – and extra reach from prime mover to machinery in pits or on elevated supports. Also, you can isolate engines or motors from dirt, moisture, fire hazards or contact with process materials.

You may be solving cost problems as well. Watson-Spicer Flexible Shafts greatly simplify alignment problems, eliminating need for costly common base plates and significantly reducing millwright time.

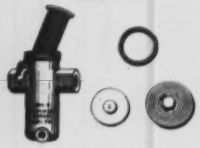
It's easy to recognize the places for flexible shafts – if you know the criteria. It's easy to choose the right sizes – if you have the engineering data. And they're easy to buy – if you know whom to call and what to specify. This is information that should be in your files. We'll be glad to send it, if you'll write and ask for Catalog F-2.

H. S. WATSON COMPANY
1316 67TH STREET, EMERYVILLE 8, CALIFORNIA
1606 LASKEY ROAD, TOLEDO, OHIO

A Complete Line of COMBUSTION ACCESSORIES for Every Industrial Liquid Fuel-Gas Installation

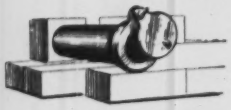
Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.

Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.



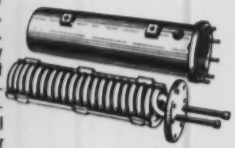
Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.

Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.



Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.

Fuel Oil Heater, Self-Cleaning, Spiral Coil Type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.



The "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil & Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation. May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

NATIONAL AIROIL BURNER CO., INC.

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Southwestern Division
2512 South Boulevard Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, AND FURNACE EQUIPMENT

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Utility Sets

A 28-page illustrated two-color catalog, Bulletin 8414, describing the new line of HS utility sets is now available from American Blower Div., American-Standard, Detroit 32, Mich.

The new bulletin describes the features and advantages of the new units. Selection factors, such as space volume, quantity of fresh air required, altitude and temperature correction, outlet velocity, duct size, static pressure and tip speed are discussed. Tables of minimum outdoor air requirements, recommended duct velocities, outlet velocity and tip speed values for backward inclined blade fans and correction ratios for temperature and altitude are included.

Liquid Control Valves

O. C. Keckley Co., 3402 Cleveland St., Skokie, Ill., manufacturer of steam and liquid control valves, announces the availability of a new illustrated condensed catalog, No. 57, which describes more than 50 of its products.

Covered in the new catalog are pressure and temperature regulators; solenoid, diaphragm, motorized and float valves; pressure reducing, flow control, safety and relief valves; strainers.

Steel Stamps, Holders

Mecco safety steel stamps, holders, fixtures and other marking devices are included in a four-page bulletin published by M. E. Cunningham Co., 1025 Chateau St., Pittsburgh 33, Pa. A feature of the bulletin is a series of charts and related data developed to take the guesswork out of ordering steel stamps.

Metal Hose, Bellows

A 16-page multi-color brochure, No. 156, describing the applications and uses of flexible metal hose and bellows has been released by Flexonics Corp., 1305 S. 3rd Ave., Maywood, Ill.

Engineering specifications and sizes, pressure ratings, materials and fitting attachments are included. Detailed drawings, pictures and charts of the various metal-formed bellows and hose are shown.

Insulating Materials

A booklet B-7206 on insulating materials is available from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

It discusses types, characteristics, and applications for Class A shellac- and varnish-coated papers, varnished fabrics, slot cell insulation and organic varnished glass. The organic varnished glass is also discussed for Class B insulation. Class H insulations discussed are silicone varnished glass, silicone rubber-coated glass cloth, and semicured silicone-treated glass cloth. Insulating varnishes, enamels, primers, finishes, and compounds are discussed by type, characteristics, and applications.

Continued on Page 94

New Books for Engineers:

AIR CONDITIONING

Willis R. Woolrich, *University of Texas; and* Willis R. Woolrich, Jr., *Consulting Engineer*

TOP AUTHORITIES in the field detail today's domestic and commercial uses of air conditioning, fully treating heating, ventilation, air purification, and cooling. Book features coverage of the special cooling difficulties presented by hot-dry, hot-humid climates. Analyzing the problems of establishing summer and winter comfort in temperate and hot climates, book stresses how psychrometric processes, radiant cooling, and the available means of refrigeration are applied to their solution. *141 illus., tables; 384 pp.* $7.50

Motion Economy and Work Measurement

Robert Lee Morrow, *Consulting Engineer*

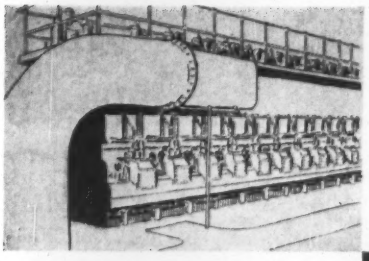
AUTHORITATIVE, PRACTICAL GUIDE to both motion economy and work measurement. Written by the man who introduced work sampling to this country, book offers unrivalled coverage of the applications of sampling techniques to work simplification, setting of time standards, and control of manufacturing operations. Thoroughly treats fatigue measurement, standard data, micromotion studies, training of time study men, and automatic machine work assignment. Objectively discusses labor-management problems. *2nd Edition. 278 illus., tables; 468 pp.* $7.50

Through bookstores or from:

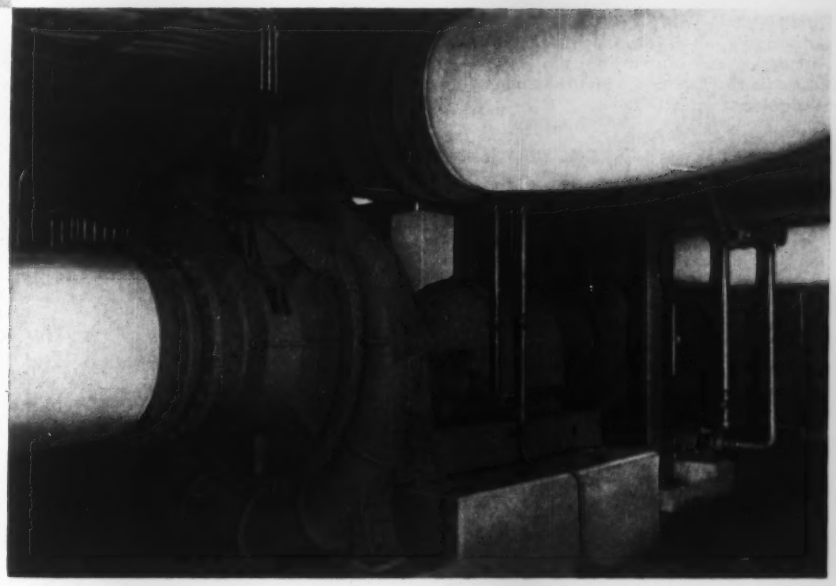
THE RONALD PRESS COMPANY
15 East 26th St., New York 10

You know those rare days when *everything's* right? Air smells good. Food tastes terrific. Even the old face looks good in the mirror. *Today* can be that kind of day. Just do two things. Call your doctor for a thorough medical checkup for cancer. Then write out a check—a nice fat one—to the American Cancer Society, and mail it to "Cancer" in care of your local Post Office.

AMERICAN CANCER SOCIETY



For diesel power



Two R-C single-stage centrifugal blowers each rated at 19,450 cfm are direct-connected to 350 Hp electric motors supplying scavenging air for two 3870 Hp Nordberg engines in this large midwestern utility company plant.

R-C centrifugal blowers supply controlled scavenging air

In matching supply to demand, the inherent characteristics of Roots-Connersville centrifugal design assure positive and accurate regulation of both volume and pressure of scavenging air. Operating at constant speed, volume and pressure can be automatically controlled by efficient inlet throttling to assure uniform delivery of required supply without the use of receivers.

R-C centrifugals may be direct-connected to high speed electric motors or steam turbines. If desired blower speed is greater than available motor speeds, speed increasing gears can be used. Because they occupy a minimum of space and are permanently balanced to hold vibration to a minimum, expensive foundations are unnecessary.

For scavenging and supercharging, or for any other application requiring close control in air or gas handling, you can depend on R-C centrifugal equipment for peak performance plus long-term operating economy. Write for Bulletin 120-B-14 for engineering and specification details.

Engineers—unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.

657 Michigan Ave., Connersville, Indiana. In Canada—629 Adelaide St., W., Toronto, Ont.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Cooling Towers

A 32-page bulletin CT-57-1, describing induced-draft counterflow cooling towers is available from Foster Wheeler Corp., 165 Broadway, New York 6, N.Y. Construction and operation of all major parts, effects of recirculation and surroundings are covered and a data sheet to help in preparing inquiries is included.

Technical Journal

First issue of a new technical journal, "Berkeley Engineering," is now available from Dept. 6322, Beckman/Berkeley Div., 2200 Wright Ave., Richmond, Calif.

The company says each issue will contain a feature article plus announcements concerning new products, applications literature and service notes.

GOSHEN GORSIL*

*Trade name for Silicone Rubber compounds custom-formulated by Goshen Rubber Co., Inc.

when it comes to SILICONE RUBBER PARTS (molded, lathe-cut or metal bonded) from CUSTOM-FORMULATED COMPOUNDS come to Goshen Rubber

A wide selection of specification-standard and custom-formulated silicone rubber compounds are at your command for precision fabrication by Goshen of products requiring properties like these:

- Resistance to temperature extremes, −80° to +500°F.
- Resiliency over a range of −120°F to +600°F.
- Low compression set.
- Resistance to chemicals, oils, oxidation, ozone, weathering, moisture, fungus, corrosion, shock, abrasion.
- Freedom from stain, odor, tackiness and toxicity.
- Same shrinkage as organic rubbers, with resultant advantages.

SEND FOR LITERATURE

This 8-page brochure and technical bulletins tell how you can put Goshen Rubber to work for you. Send for your free copies today!

See our catalog in Sweet's Product Design File.

PUT Goshen Rubber TO WORK FOR YOU

GOSHEN RUBBER CO., INC., 3887 S. TENTH ST. GOSHEN, IND.

Oil Seals

A 68-page illustrated condensed oil seal catalog of stock seals is available from Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago 22, Ill.

The catalog, No. 856-C, lists all oil seals carried in stock with accompanying stock numbers and part numbers. Prefacing the stock seal listings is a complete section describing and illustrating the various materials available for use as sealing members. These include Sirvis leather, Sirvis-Conpor (elastomer impregnated) leather which permits self-lubrication without objectionable leakage, and a wide range of Sirvene (synthetic rubber) compounds.

Petroleum Engineering

Bulletin No. 2547, published by Blaw-Knox Co., Chemical Plants Div., Pittsburgh, Pa., describes the engineering and construction services the firm provides for the petroleum industry.

The 28-page brochure lists a broad line of refining processes and illustrates numerous types of units designed and engineered for firms in the petroleum and petrochemical industries.

Titanium Pipe

A technical data folder published by Tubular Products Div., Babcock & Wilcox Co., Beaver Falls, Pa., discusses the seamless titanium metal pipe and tubing produced by the Division.

The folder presents in detail the size range and tolerances as well as a complete description of the mechanical, physical and working properties of the metal in tubular form. The bulletin is designated TDC-1850.

Silicon Carbide Elements

Globar Div., Carborundum Co., Hyde Park Blvd., Niagara Falls, N. Y. has announced a 12-page booklet covering its silicon carbide heating elements.

This folder covers information on handling, unpacking, storage, installation and replacement of heating elements. It is enclosed in a envelope designed for hanging on wall next to furnaces for ready reference.

Automation Valves

"Valves for Automation in the Steel Mills" is a new 16-page bulletin published by Golden-Anderson Valve Specialty Co., 1223 Ridge Ave., Pittsburgh 33, Pa.

The bulletin No. SM-1, schematically shows various piping and valve arrangements for supply water from source to mill; emergency city connection; valves for liquid level control; emergency fire protection; spray valves for hot strip mills; coke quenching and drain valves; preventing flywheel explosion.

Copies of this new bulletin SM-1 may be obtained from this publication or direct from Golden-Anderson Valve Specialty Company.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Bevel Gear Units

Standardized right angle bevel gears for industrial applications are illustrated and described in Bulletin 57 published by Airborne Accessories Corp., 1414 Chestnut Ave., Hillside, N. J.

Line drawings give the dimensions of the three standard sizes: 5, 1 and ¼ hp. All are available as two-way or three-way types and with 2:1 or 1:1 shaft ratios. A table of basic model data lists the rated horsepower and speed for 12 standard models and gives for each the static torque from the outthe shaft diameter and weight. Two graphs show the recommended continuous duty ratings for 1:1 ratio units in the three sizes.

Flexible Conveyor Belt

A new conveyor belt engineered for small diameter pulleys is described in a bulletin published by Main Belting and its parent company, Russell Mfg. Co., 175 E. Main St., Middletown, Conn.

Developed jointly by the two companies, S. C.-18 is said to combine the flexibility of solid woven belting with the superior strength and low elongation characteristics of stitched canvas conveyor belting. This flexible belt can be used for general purpose conveying over pulleys or end rolls as small as 3½ in. in diam or less, according to the manufacturer.

Fire Protection Systems

A discussion of the nature and advantages of fire protection systems is available from "Automatic Sprinkler Corp. of America, Youngstown 1, Ohio.

Bulletin 66, "The ABC of Fire Protection" contains 36 pages, is illustrated, and printed in two colors. Included is an explanation of the insurance savings and other economic benefits which fire protection makes possible. Examples are given. The fire protection components and systems manufactured by the firm are described and pictured. The bulletin includes a two-page, two-color chart of the applications and functions of different types of systems.

Electrolizing Process

How electrolizing overcomes friction, wear, abrasion, galling and fretting corrosion problems and increases mechanical reliability is described and documented in a 24-page booklet issued by Electrolizing Corp., 1505 East End Ave., Chicago Heights, Ill.

The booklet explains that it is a proprietary process which deposits a hard, dense, nonmagnetic alloy on the surface of the basis metal being treated. Electrolizing of parts is performed in the four plants of the corporation. High surface hardness (70–72Rc), very low coefficient of friction, excellent antiseizure characteristics are among the properties claimed for the deposit. Fatigue and tensile test comparisons as well as an Amsler wear test report are included in the booklet.

Fabricated Parts

An eight-page brochure illustrating and describing the firm's fabricating facilities maintained at its Evendale, Ohio plant is available from Formica Corp. The bulletin, Form 742, also lists several examples of how the company designed better parts for less money.

Hydraulic Hose Fitting

A card Bulletin 4433B1, for hanging on the wall, giving instructions with pictures of two steps in assembling nonskive Hoze-lok fittings to rubber covered, wire braid hose is available Tube & Hose Fittings Div., Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

DRAFTING
at Your Own Desk
or Wherever You Go . . .

with UNIVERSAL'S *New*
DESK-TOPPER
popular-priced Drafting Machine ensemble

You don't need a drafting room! Sketch or draw right at your desk, out in the plant or at home with Universal Desk-Topper . . . the professional, personal-size drafting machine, engineered to fine precision standards of accuracy and operation. Complete with folding drawing board, metal scales, instrument boxes. Sets up in two minutes! Portable, easy to use! Write for information.

$62.50 without drawing board — $74.50 complete

SAVES UP TO 50% DRAWING TIME!

UNIVERSAL DRAFTING MACHINE CORP.
7960 LORAIN AVENUE • CLEVELAND 2, OHIO

Are they hiding your light under a bushel?

. . . under a bushel of detail work? Are you lost in an acre of engineers? Are you so tired of hoeing the same old row, you're ready to slaughter a sacred cow . . . or two? This is no way to enjoy engineering! You can avoid this kind of situation by choosing a company that places a premium on creative ability . . . individual initiative.

Take the Tonawanda Engineering Laboratories of LINDE for example. LINDE engineers have draftsmen to do their drawings . . . technicians to do their routine bench work. Each man shares his office with only one or two others. This atmosphere, free of tiresome, routine chores, encourages the solution of tough engineering problems . . . makes it easier to demonstrate qualities for advancement.

This is pretty heady stuff . . . and not every engineer can qualify. The work is in the production and distribution of atmospheric gases as gases and as low temperature liquids. The background required is in thermodynamics, heat and mass transfer, and stress analysis as applied to pilot plants, equipment development, process engineering and plant design.

There are a limited number of important opportunities available now. If you consider yourself one of the better engineers, write to Mr. R. P. Kalle, Dept. ME-6, Linde Company, Division of Union Carbide Corporation, P. O. Box 44, Tonawanda, N. Y.

For additional opportunities in the midwest, see our ad on page 170

Linde

UNION CARBIDE

50 YEARS OF LEADERSHIP

The terms "Linde" and "Union Carbide" are registered trade-marks of Union Carbide Corporation

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Lubricating System

Bulletin No. 70, an eight-page illustrated brochure, describes Lubrival, a new type of circulating oil system developed by The Farval Corp., 3249 East 80th St., Cleveland 4, Ohio for application on presses and semi-automatic or automatic machine tools with built-in return oil arrangements.

The new product monitors its own operation through a pressure sensing mechanism to warn of clogged or broken lines in any part of the system, the firm states.

Research Microscope

A 20-page booklet describing and illustrating its new Series R research microscopes has been published by Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.

The booklet, No. D-1057, discusses the firm's 14 different research microscope models in detail. Also included is information on a full line of accessories and a price list.

Aluminum Aircraft Castings

American Brake Shoe Co., 230 Park Ave., New York has published a six-page folder on aircraft castings of Ductaluminum 356.

They are produced in two strength levels with guaranteed minimum mechanical properties in critical areas (specified by the designer) of the actual castings. Strength levels for 356T are 38,000 psi tensile, 28,000 psi yield, and 6 per cent elongation; for 356S they are 42,000 psi tensile, 35,000 psi yield, and 3 per cent elongation.

Speed Reducers

Details on an improved and extensive line of speed reducers are presented in Bulletin CD-218 released by Cone-Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12 Mich.

Standard stocked capacities of the reducers range from fractional to 665 hp with reduction ratios from 5:1 to 70:1. The 24-page bulletin contains specifications for standard extended shaft and shaft mounted models. Dimensioned assembly drawings plus tables of mechanical and thermal hp ratings, output torque ratings and chain pull ratings are provided for all models.

Semi-Steel Valves

A revised 43-page bulletin, V-203, Rev. 1, covering the firm's semi-steel valve line has been issued by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

The new bulletin, which supersedes a 35-page earlier edition, has a number of new features including two full pages of photos, drawings, and detailed description of Rockwell-Nordstrom lubricants and lubricating methods; and large cutaway photos showing in detail the working parts of four principal types of semi-steel valves—two-bolt cover, screwed-gland, bolted-gland, and multiport types.

Continued on Page 98

From Lilliput to Brobdingnag–

Via Research

Gulliver, with considerable aplomb, blithely traveled through the never-never land of giants as tall as church steeples and through the land of the little people, six inches tall. In these strange lands he unwittingly, but consistently, came a cropper.

As boiler makers, we too are confronted with strange lands. Boiler pressures have reached the supercritical, that area of pressures above 3,200 pounds per sq. inch where water and steam lose some of the behavior patterns we have known so well. Steam temperatures have increased, pressing the metallurgist to provide better materials to contain them. And all the while, boiler capacities have jumped by leaps and bounds. In short, the quest for greater efficiency has necessitated the development of boilers of Brobdingnagian proportions.

Currently Combustion is designing a boiler which will set new world records for steam pressure and temperature – 5,000 pounds per square inch and 1200°F. Its predicted performance indicates that it will be the most efficient boiler ever built. In cooperation with the Philadelphia Electric Company, in whose Eddystone Station this 16-story high boiler will be installed, we have designed and built a Lilliputian version of this unit at our Chattanooga plant. Thus, unlike Gulliver, who wandered into the land of the giants without knowing what difficulties might confront him, we have turned the light of research on the road ahead. By duplicating the conditions of pressure and temperature, and by using the same metals and the same pure water that will be used at Eddystone, the test unit enables C-E engineers to study virtually all phases of the design of the multi-million dollar boiler, before it is built.

There are many roads from Lilliput to Brobdingnag. The only sure one is the route of research. The ills that befell Gulliver are funny—only in a fable.

Architect's drawing of Eddystone Station.

COMBUSTION ENGINEERING

Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

All types of steam generating, fuel burning and related equipment; nuclear reactors; paper mill equipment; pulverizers; flash drying systems; pressure vessels; ball pipe

FRICK

Refrigeration Serves Big Armour Laboratories

Armour and Co. use "cold" in many ways in their great Pharmaceutical Laboratories, recently opened near Kankakee, Ill. These uses include air conditioning, biological process work, cold storage, heat-pump service, and research.

Temperatures can be held anywhere between −45 and +45 degrees F., but usually go no lower than −10.

Here a 2-stage Frick system of 1422 tons refrigerating capacity operates with efficiency and economy. Installation by Midwest Engineering and Equipment Co., Frick Sales-Representatives in Chicago.

Four of eight ammonia compressors furnishing refrigeration at temperatures down to −45° F.

For that important refrigerating, air conditioning, ice making or quick freezing job of yours, look to dependable Frick equipment. Sales-engineering and service, the world over. Let us submit estimates now: write, wire or phone

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U. S. A.

Introducing the NEW, BIGGER 56 HP. Model VR4D WISCONSIN HEAVY-DUTY *Air-Cooled* ENGINE...

Model VR4D Open Engine with heavy-duty clutch, rotating screen, electrical equipment and pre-cleaner.

• Climaxing years of engineering development, this great new engine offers manufacturers and users of power equipment all the advantages of AIR-COOLING, at temperatures from low sub-zero to 140° F., in an exceptionally rugged engine that measures up to any "heavyweight" industrial type liquid-cooled engine, horsepower for horsepower, with many *plus values.*

The outstanding High Torque characteristic of the Model VR4D engine, combined with its extremely rugged construction and heavy-duty stamina, provide *load-lugging holding power,* long life and top power performance.

Advanced "V" design provides an extremely compact power package, plus all traditional Wisconsin heavy-duty features such as tapered roller main bearings.

This new engine rounds out a complete line, comprising 15 models in 4-cycle single cylinder, 2- and 4-cylinder sizes, from 3 to 56 hp. Write for "Spec" Bulletin S-207.

WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Molding Presses

Redesigned Model 741 series of fully-automatic compression molding presses is described in a 12-page catalog, No. 200, published by the Plastics Molding Equipment Div., F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.

The catalog points out features of the new presses which were designed to make every operation, from loading to discharge, independent of human error, reduce production costs, provide fast operating cycles, assure high output per cavity, simplify set-up, and protect the mold from damage.

Release Agent

A bulletin published by Smooth-On Mfg. Co., 572 Communipaw Ave., Jersey City 4, N. J., describes a newly developed release agent called Sonite Seal-Release that can be rubbed to an imperceptible film for easy parting of epoxy resin castings from plaster molds, or from metal, wood, or epoxy masters.

Technical Bulletin 19 includes the prices of various quantities of the material and describes methods of applying the material by rubbing, brushing or spraying. Use with materials such as plaster or gypsum for making of case molds, and plaster or formed styrene sheets for making vacuum molds is also covered.

Boiler-Burner Units

Bulletin 900, describing its line of boiler-burner units has been released by International Boiler Works Co., 641 Willow St., East Stroudsburg, Pa.

The units are available for low or high pressure hot water or steam service. Type BBL Units, for low pressure heating, are available in 18 sizes ranging from 1,072,000 to 16,750,000 Btu per hr hot water, 32 to 500 hp steam. Type BBH Units, for high pressure hot water or steam, are available in 17 sizes ranging from 670,000 to 20,100,000 Btu per hr hot water, 20 to 600 hp steam.

Gas Regulators

An eight-page bulletin, No. 1024-6, describing the firm's line of high pressure regulators has been issued by Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.

A feature of the revised bulletin is a page of description, photos and drawings of the firm's recently introduced high-pressure 141 regulator, which will withstand momentary overloads as high as 1000 psi on the outlet side without damage to the regulator.

Use a CLASSIFIED ADVERTISEMENT *for Quick Results*

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Block Insulation

Ehret Magnesia Mfg. Co., Valley Forge, Pa., announces the availability of a bulletin covering the company's line of calcium silicate insulations for temperatures up to 1200 F. This new material, with the tradename "Thermasil," is used in the power and process industries.

The six-page bulletin gives basic sizes of insulation for pipe covering and block for process vessels or other equipment. Included also are data on basic features which suit the new material to present-day requirements. Physical properties are tabulated and thermal conductivity given in graph form.

Plastic Valves

A 16-page illustrated bulletin describing polyvinyl chloride valves and fittings has been issued by Walworth Co., 60 E. 42nd St., New York, N. Y.

The valves and fittings, offering exceptional resistance to most salts, alkalis and acids, are designed for piping systems in food processing, chemical processes, petroleum refining, pulp and paper mills, marine equipment. The bulletin presents four pages of application tables on the performance of normal impact PVC and high impact PVC valves and fittings for handling about 315 different fluids that attack other materials.

Screw Pumps

Basic construction and design of a line of standard screw pumps are shown in a new bulletin, S-206, of Warren Pumps, Inc., Warren, Mass. Featured are those of double external bearing and gear type, and double external bearing and gear hopper type.

Flat Nut Fasteners

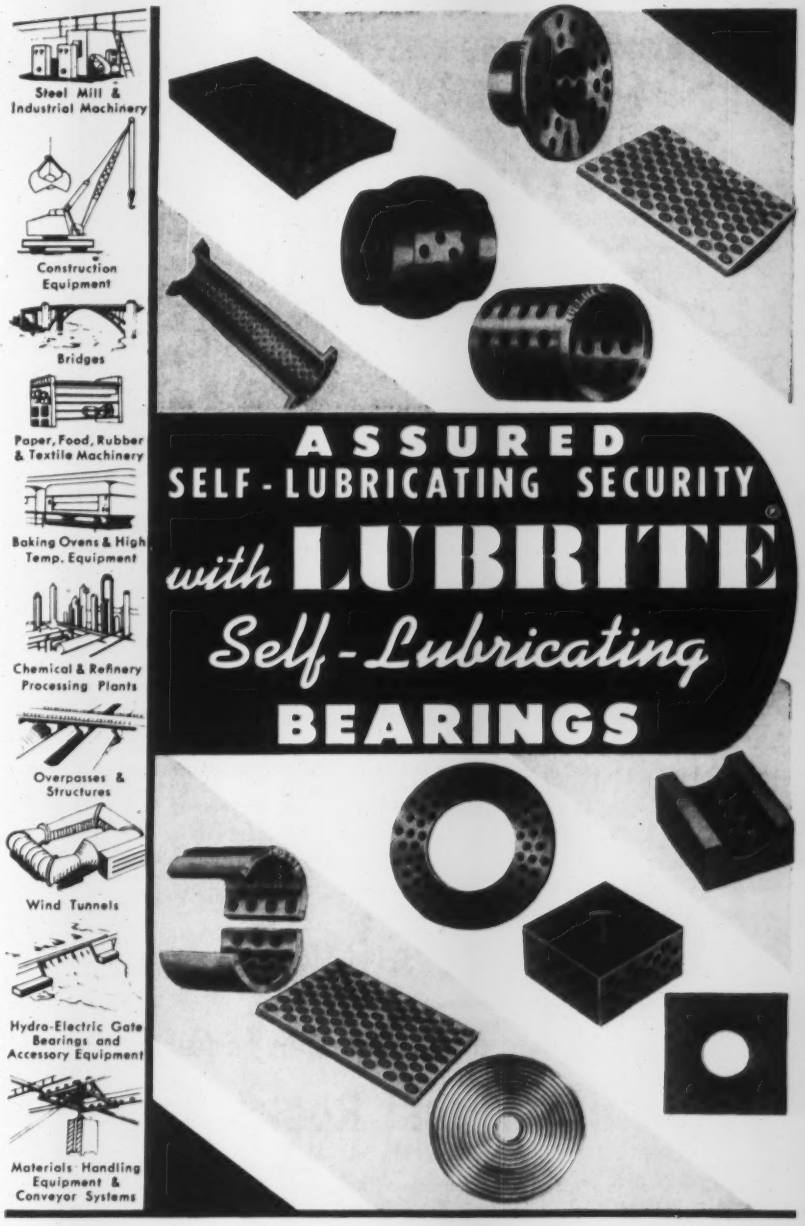
New specification type literature on its standard design flat nut fasteners is available from Prestole Corp., 1345 Miami St., Toledo 5, Ohio.

Data on length, width, material thickness, screw size, and other information of importance is included. Four pages of information on fasteners are available, covering parts made from spring steel and low carbon steel. Flat nut fasteners designed with welding nubbins, without welding nubbins, and with rivet holes, for various attaching methods, are listed and illustrated in detail.

Nuclear Shielding

An eight-page brochure describing its nuclear shielding product line has been issued by Ameray Corp., Nuclear Products Div., Route 46, Kenvil, N.J.

The brochure illustrates types of equipment and materials for gamma ray protection. Included are zinc bromide, water filled, and lead glass protective windows; reactor doors; portable shields, portable lead containers; lead plugs; safes, and irradiation chambers; protective bricks and blocks; and lead lined fume hoods.



Lubrite self-lubricating bearings offer great versatility in hundreds of fields where dependability and superior performance are of prime importance.

Lubrite Bearings, with clean, permanent, maintenance-free self-lubrication are designed to withstand severe loadings, temperature extremes, submersion, corrosion and other adverse conditions.

Lubrite may be just the bearing you need in your designs to obtain better results.

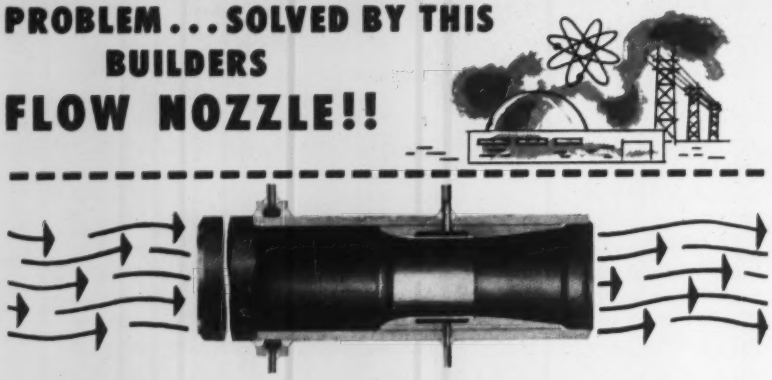
Consult our Engineering Department on your application. No obligation.

Manual No. 41. A 20-page book filled with complete information, technical data, and specifications about Lubrite Self-Lubricating bushings, bearings, and washers for industrial equipment, machinery, and hydro-electric type applications.

Manual No. 55. Contains complete information, technical data, and specifications about Lubrite Self-Lubricating Expansion Plates and Bushings for bridges, buildings, refinery equipment and chemical processing equipment applications. Write Today!

LUBRITE DIVISION
MERRIMAN BROS., INC.
181 AMORY STREET, BOSTON 30, MASS.

PRODUCTIVE ATOMS POSED A "HOT" METERING PROBLEM... SOLVED BY THIS BUILDERS FLOW NOZZLE!!



This Flow Meter is in the primary loop of every major atomic reactor in America — from the Nautilus to the Shippingsport Power Plant.

- Only flow nozzle offering the accuracy, range, low head loss, freedom from upstream disturbances, and other desirable characteristics of the Venturi Tube.
- Built to ASME pressure vessel code.
- Designed for high temperature — high pressure applications (power plants, high pressure lines, atomic reactors, etc.).
- Nozzle can be factory inserted in any customer-supplied high cost, special pipe at considerable savings.
- Completely drainable on modified designs; modified versions excellent for slurries.
- Design based on the most comprehensive compilation of primary element/fluid flow data available anywhere.

Let Builders application engineers solve your flow metering problems.

BUILDERS-PROVIDENCE
DIVISION OF
B-I-F INDUSTRIES

Write Builders-Providence, Inc., 382 Harris Avenue, Providence 1, Rhode Island.

Servo Engineers

Work where your training and experience can be fully utilized:

in High Thrust Rocket Engines

The spectrum of servo work at Rocketdyne is very broad: electronic, mechanical, hydraulic, pneumatic. New approaches...new methods...new materials...must be constantly explored. That's part of the extreme interest of the work. This is a place for the man who is strong on systems analysis.

Your assignment will be the Mixture Ratio Controls, Thrust Controls, and Pressure Controls that govern the performance of the most powerful engines man has ever devised. They must cope with changing mass as fuel is used up, withstand conditions of heat, cold, G, lapse of atmospheric drag, vibration, varying combustion efficiency. Precise control of the power plant is mandatory in order for the guidance system to accomplish its mission.

You won't be bogged down in routine at Rocketdyne. You'll be able to concentrate on analyzing completely new problems and coming up with the answers...and on gaining valuable new experience in an advanced servo field. Write: A. W. Jamieson, Rocketdyne Engineering Personnel Dept. ME-6, 6633 Canoga Avenue, Canoga Park, California.

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

BUILDERS OF POWER FOR OUTER SPACE

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Expansion Joints

Rubber, neoprene, and Teflon-lined expansion joints, their construction, sizes and uses are fully explained in a recent bulletin issued by Garlock Packing Co., Palmyra, N. Y.

The bulletin describes the characteristics and limitations of spool-type expansion joints, rectangular-type expansion joints, U-type joints, all-Teflon expansion joints, all-Teflon flexible couplings, full-face Teflon lined rubber expansion joints, expansion joints for use on piping and flanges manufactured by Haveg Corp. and the Duriron Co., Inc.

Noise Control

An eight-page illustrated brochure, "Noise Control" has been published by Allied Witan Co., 12500 Bellaire Rd., Cleveland, Ohio.

The brochure illustrates with charts and photographs the applications of the new pneumatic mufflers for the elimination of exhaust noises of air operated equipment. The charts illustrate the performance data of the mufflers in frequency and attenuation levels in decibels, loudness and attenuation levels in sones, air flow CFM, noise levels and attenuation levels at various airline pressures.

Weather-Protected Motor

Features designed to contribute to outdoor dependability of the firm's weather-protected motors, Type FOD, in ratings from 250 to 900 hp are described in Bulletin 51B8606A released by Allis-Chalmers Mfg. Co., Box 512, Milwaukee, Wis.

The motors feature a sturdy steel frame, a removable pre-wound stator assembly, proven insulation, capsule-mounted split sleeve bearings, removable air ducts, and protective screens. Standard Class A insulation is available at voltages to 4160 at a temperature rise of 50 C. They are also available with "Silco-Flex" insulation to provide stator coils impervious to moisture, highly resistant to abrasion, and thermally stable at high temperatures.

Metal Working Machinery

"Metal Working Machinery," Catalog No. 26, 68 pages, has been issued by Julius Blum & Co., Inc., Carlstadt, N. J. It describes a variety of shop equipment and supplies, with special emphasis on the requirements of small and medium size metal fabricators.

Subjects covered include equipment for bending, grinding, punching, shearing, sawing, welding, forging, drilling, tapping, threading, notching, materials handling. The catalog describes the products of many nationally established manufacturers, including several items designed and built especially for Julius Blum & Co. Among these are a bar twisting machine, a line of punching and angle shearing machines for structural and miscellaneous steel fabrication, a power driven hydraulic press for bending, straightening.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Stainless Steel

A technical data sheet on a special stainless steel that is used for jet engine parts high pressure steam valves, and steam and gas turbine parts is now being distributed by Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.

The four-page sheet is entitled "Allegheny Stainless Steel Type 418 Special." Technical data including physical and mechanical properties, resistance to corrosion and oxidation are included. Type 418 special is recommended by the firm for application in the 750 to 1100 F range.

Aluminum Pipe

Aluminum pipe for tank and vessel hook-up is the subject of an illustrated brochure published by Reynolds Metals Co., 2500 S. Third St., Louisville 1, Ky.

Featured are reference tables scheduling sizes and specifications of pipe available through leading distributors across the nation. Aluminum piping products are manufactured to standard pipe sizes, according to the brochure, eliminating costly conversions and special fittings. The smooth interior of the piping is said to insure lower pressure drops and higher flow efficiencies.

Recording Oscillographs

An eight page folder, illustrating and describing five models of its multi-channel rack mounting oscillographs, has been published by the Brush Electronics Co., Div. Clevite Corp., 3405 Perkins Ave., Cleveland 14, Ohio.

The instruments permit simultaneous recording of up to eight phenomena in chart-form. They feature an electrically-controlled transmission which allows instantaneous switch selection of 16 different chart speeds ranging from 10 in. per second to 10 in. per day. When used with Brush amplifiers, recordings may be made over a frequency range extending from d-c to 100 cps.

Adhesives, Coatings, Sealers

Adhesives, protective coatings and sealers are described in a four-page folder, Bulletin No. 650A, published by Raybestos-Manhattan, Inc., Bridgeport 2, Conn.

The recommended use, method of application and properties of eight typical adhesives, representative of basic types of adhesives, coatings and sealers made by the firm are summarized and presented in tabular form. A graph shows the shear strength of five thermosetting adhesives in the temperature range from 100 to 650 F.

Machine Lubrication

How to solve maintenance problems by making a changeover from manual machine oiling to automatic lubrication is covered in a six-page illustrated Bulletin, A-7, offered by Bijur Lubricating Corp., 151 W. Passaic St., Rochelle Park, N. J.

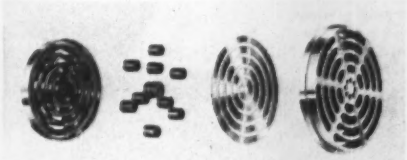
The pamphlet explains how such systems provide dependable performance with minimum downtime in the packaging field. A detailed inspection at a number of manufacturers provides specific methods of lubricating enclosed bearings, preventing product spoilage or contamination, and keeping production at maximum levels.

Separator Catalog

A 22-page catalog No. S-56-1, describing vibrating screen separators has been issued by Southwestern Engineering Co., 4800 Santa Fe Ave., Los Angeles 58, Calif. This equipment is used for the separation of solids from liquids and the screening of all types of dry materials.

The catalog presents operating and application data on the separators for a wide range of process industries, including chemicals, food, paper, petroleum, ceramics, metals, rubber, paper, sand and gravel, waste disposal.

VOSS VALVES in your machine mean



LESS MAINTENANCE, FEWER SHUTDOWNS for your compressor. (air, gas, ammonia)

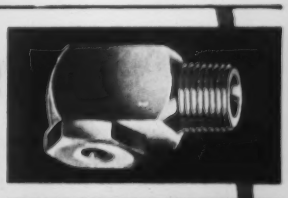
• up to 40% more valve area • minimum pressure loss • higher efficiency • less power consumption • normal discharge temperature • quiet, vibration-free • utmost safety • lower operating costs

VOSS VALVES are made to specification, machined from solid stock (not cast) —VALVES and PLATES are of heat-treated alloy or stainless steel; PLATES are machined, not stamped, and ground for precise close-tolerance fit; are dimensionally stable...ductile...resist fracture, high temperatures and corrosion...withstand fatigue. SPRINGS, of heavy rectangular sections and large diameters, add to dependability and safety.

Our detailed proposal will be sent without obligation. Send name, bore, stroke and speed of machine.

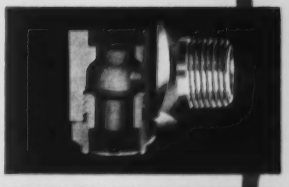
VOSS VALVES J. H. H. VOSS Co., Inc. 785 East 144th Street, New York 54, N. Y.

Spray Nozzle types choice of over 12,000 basic designs



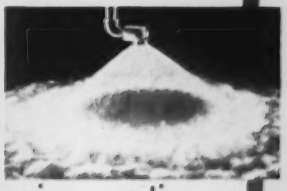
materials

brass, stainless steel, lead, hard rubber, hardened steel, tungsten carbide and many others.



performance

uniform distribution with spray angle, capacity, impact and atomization to your specifications.



to improve every spraying operation

Improve performance, lower spraying costs with Spraying Systems spray nozzles. Prompt delivery. For complete information write for Catalog 24.

SPRAYING SYSTEMS CO. 3265 RANDOLPH ST. • BELLWOOD, ILL.

ADVANCED SPRAY NOZZLE DESIGN FOR NEW DIMENSIONS IN CONTROL AND PERFORMANCE

Precision Optics

Precision optics are described in two bulletins available from Texas Instruments, Inc., Optics Div., 104 E. Foothill Blvd., Monrovia, Calif.

The division specializes in the design and manufacture of an intricate and complex optics for civilian and military use. Bulletin No. 0-104 describes flat, cylindrical, prismatic, spherical, and aspherical components for recording oscillographs, fire control, photographic, projection, missile, ultraviolet and infrared applications. Bulletin No. 0-105 describes infrared optics expressly for use in hyper-sensitive infrared systems.

Contact Meter-Relays

Contact meter-relays said to indicate and control almost any physical or chemical condition that can be detected electrically, are described in a new 40-page catalog, No. 4-C, available from Assembly Products, Inc., Chesterland, Ohio.

The catalog supplies information for ordering meter-relays intended for use in original equipment or in self-contained control packages. Various circuits for providing different types of control action are discussed. Also included in the catalog are API panel meters and auxiliary control components.

Commercial Glasses

A 16-page bulletin, Properties of Selected Commercial Glasses, B-83, has been completely revised and is now available from Corning Glass Wks., Corning, N. Y.

Several new glasses have been added to the property data chart, including aluminosilicate glass, low loss iron sealing glass, fused silica, and radiotron tube and capacitor glass. The bulletin discusses mechanical, thermal, electrical and chemical properties of glass in the text. Viscosity temperature curves for several commercial glasses, and heat transmission data are also included.

Custom-Molded Plastics

A new booklet on plastics manufacture, "Custom-Molded Plastics for Industry," has been made available by Sylvania Electric Products Inc., Warren, Pa.

The 12-page booklet includes illustrated sections on molding facilities, finishing and assembly of components, research and development, and quality control. Chapters on injection molding, compression molding, and transfer molding list examples of automatic equipment used in the molding of thermoplastic and thermosetting materials at the company's newest plastics manufacturing plant in Warren.

Diesel-Engine Compressors

Integrally-built diesel-engine compressors for use in industrial plants, mines, large construction projects, and chemical plants are shown in a new bulletin, Form 3207, released by Ingersoll-Rand, 11 Broadway, New York 4, N.Y.

The unit featured combines a four cycle V-angle heavy duty diesel engine and the slow speed horizontal compressor on a single crankshaft, without the use of gears or other coupling mechanism. Designated as the SVO compressor, it is built for continuous full-load operation for installation in isolated locations or where additional compressor capacity must be obtained without additional demand on existing power facilities.

Gas Heating Equipment

A comprehensive catalog, GN-57, covering the firm's line of gas-fired commercial and industrial heating equipment has been published by Reznor Mfg. Co., Mercer, Pa.

Equipment shown includes suspended gas unit heaters, both fan and blower types, in capacities from 25,000 to 300,000 Btu; Flexitemp floor model heater; two series of duct furnaces for system capacities from 50,000 to several million Btu; and the PAC, a horizontal furnace in sizes from 50,000 to 125,000 Btu.

BREATHER-FILTER

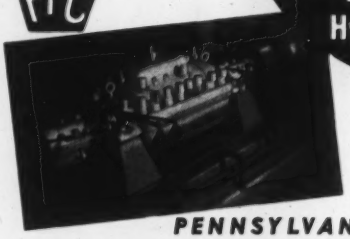
protects housings, crankcases, storage tanks.

The Air-Maze breather-filter keeps dust out of engine and compressor crankcases, gearcases, hydraulic equipment, liquid storage tanks and machinery. Types and sizes available in both oil-wetted and oil bath models to protect every vented housing.

In the oil-wetted type, dust is impinged on a series of oil-wetted wire baffles. In the oil bath type, used where the dust concentration is unusually high, the filter media is enclosed in a bowl. Outside air must first pass through the oil, then the filter media, before entering crankcase or housing. Also functions as a backfire flame arrester.

Available in sizes from 1/8" to 3 1/2". Permanent, all-metal, easily cleanable. Write for booklet BC-453. Made by AIR-MAZE CORPORATION, Cleveland 28, Ohio.

PPC



You Get Dynamic Hydraulic Balance with

PENNSYLVANIA

MULTI-STAGE THRUSTFRE Centrifugal Pumps

All axial forces are balanced in this THRUSTFRE design. Thru the correct design of the shaft bushing between the opposed impellers, external thrust-control devices are eliminated. This dynamic, hydraulic balance design reduces parts subject to wear and replacement, gives greater operating economy, assures dependable service with minimum maintenance. Write for descriptive bulletin A-242 that shows you too can profit by the many exclusive features found in Pennsylvania Multi-stage Thrustfre Centrifugal Pumps. Performance-proved in hundreds of installations. Discharge pressures to 1200 psig.

PENNSYLVANIA PUMP & COMPRESSOR COMPANY

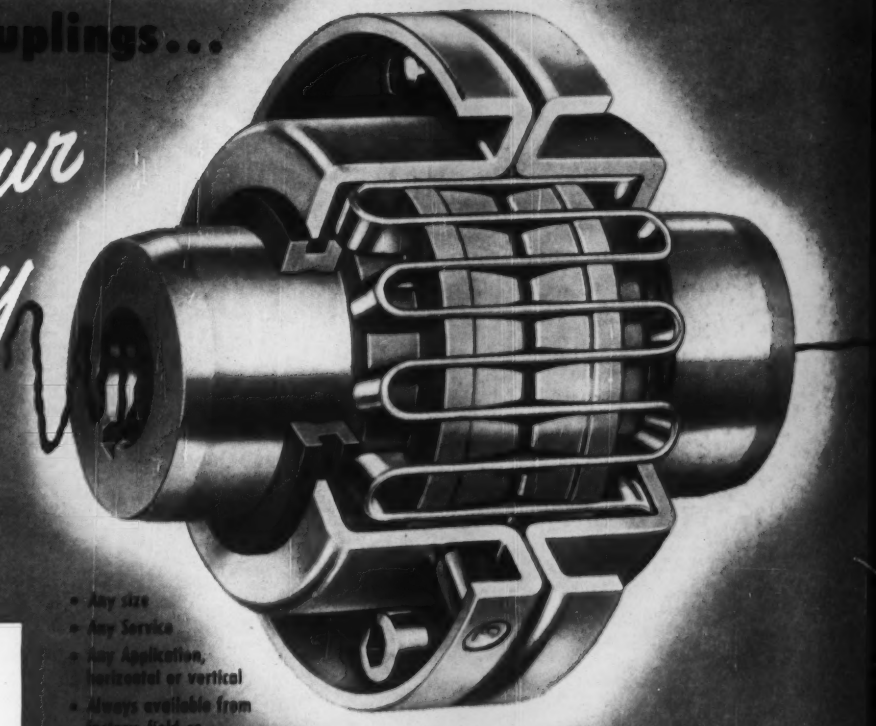
Main Office & Works, Easton, Pennsylvania

AE-PP328-956 EARNING CONFIDENCE SINCE 1920.

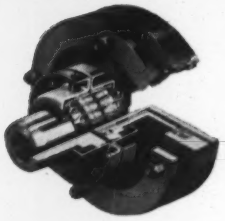
PENNSYLVANIA PPC PUMP AND COMPRESSOR COMPANY

Falk Steelflex Couplings...

Protect your machinery in 2 ways



- Any size
- Any Service
- Any Application, horizontal or vertical
- Always available from factory, field or distributor stocks

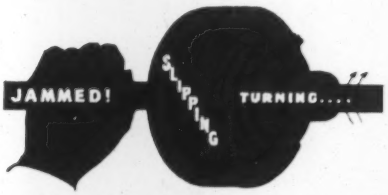


Falk Controlled Torque Couplings prevent damage from overloads

In applications where danger from overloads exists, use the FALK Type FT Controlled Torque Coupling. The Type FT has all the features and advantages of standard FALK Steelflex couplings—and, in addition, has an adjustable friction slip clutch, enabling the operator to set the coupling to slip at any predetermined overload.

This controlled-torque principle not only prevents transmission of dangerous shocks and limits overloads; it eliminates the breaking of shafts caused by jamming of driven equipment.

An outstanding advantage of the Type FT Coupling is that, as soon as the cause of the overload is removed, the entire coupling will rotate and transmit power without replacing parts or repairing coupling.



There's real economy in using Type FT Controlled Torque Couplings. Many users have reported that these couplings paid for themselves the very first time they slipped (under overload) because of the protection against damaged driving or driven machinery!

...cost less per year of service!

You get *double protection* when you connect your driving and driven machinery with a Falk Steelflex Coupling—the all-steel coupling with the exclusive grid-groove design! First, its *torsional resilience* smothers shock and vibration; and second, the Steelflex design prevents damage and lowered efficiency by accommodating shaft misalignment.

Why have increasing numbers of key men in industry standardized on Falk Steelflex Couplings? Their experience has proved that Falk Steelflex Couplings prolong the service life of their machinery... are trouble-free and need minimum maintenance . . . are easy to install, lubricate and disconnect . . . and *cost less per year of service* than ordinary couplings.

One basic Steelflex design—the type F, in its many sizes—is adaptable to more than 90% of all industrial applications. For applications involving danger from overloads, Modified Type FT Controlled Torque couplings (see column at left) are ideally suited. There are numerous other special or dual purpose Steelflex couplings for unusual applications. **Write to Department 247** for engineering bulletin, including selection and dimension tables.

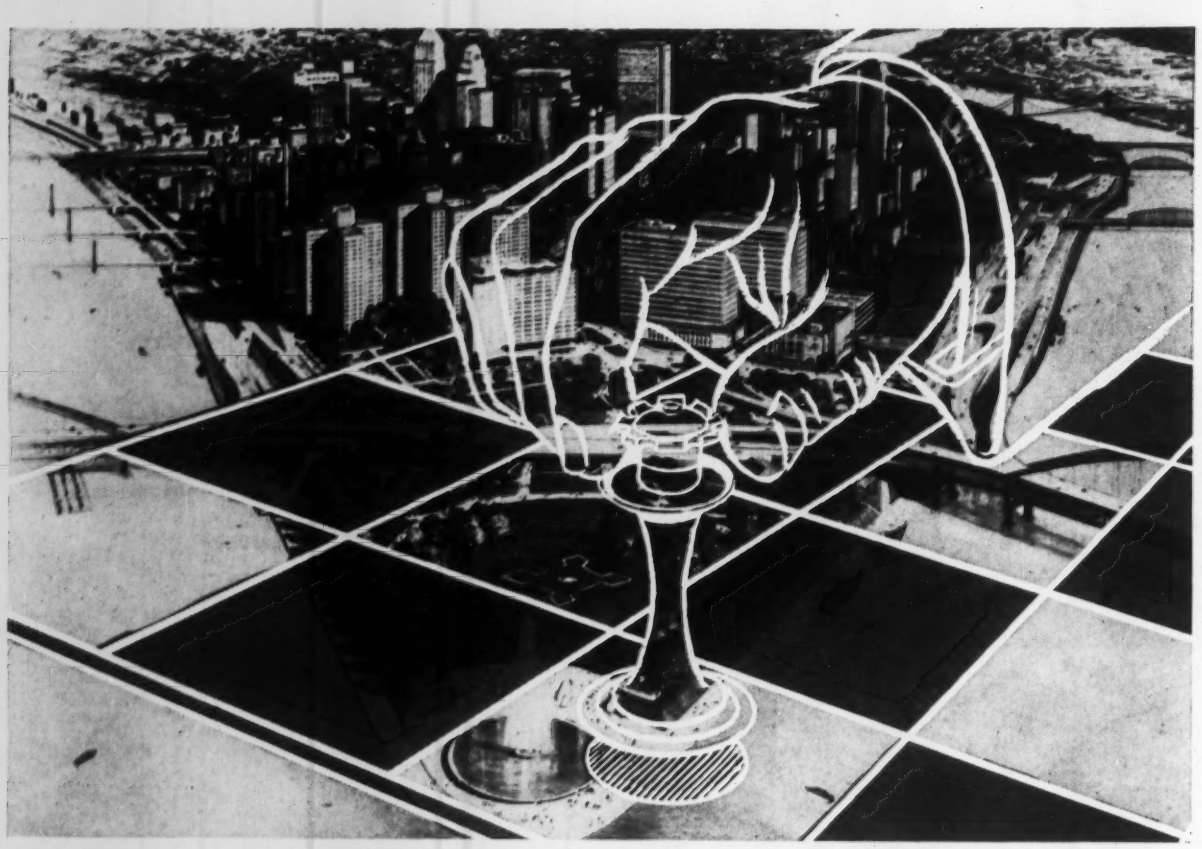
THE FALK CORPORATION, MILWAUKEE, WISCONSIN

FALK

...a good name in industry

MANUFACTURERS OF:

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining



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An exciting career with WESTINGHOUSE
—First in Atomic Power . . .
A wonderful way of life in PITTSBURGH
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It's the wise engineer who is making the move to WESTINGHOUSE—PITTSBURGH. Not only is he contributing his talents to the important task of building America's ATOMIC FLEET, but he is experiencing the wonders of living in the NEW Pittsburgh. No city in the United States has undergone the metamorphosis of this great metropolis; and the extraordinary results are evident everywhere—from the new, safe, wide highways to the delightful tree-lined, residential communities. For a way of life that is truly fit for a "king," the smart move is to PITTSBURGH, and an ATOMIC POWER career with WESTINGHOUSE.

Send your resume to: Mr. John D. Batey, Dept. #M-2
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Responsible positions that offer immediate opportunities.
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ELECTRIAL ENGINEERS

Degree; design, application, test and analysis of instrumentation and control systems and components.

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For liaison. Power Plant machinery layout. Some stress, supervise final installation. Degree required.

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Mechanical engineers for design and manufacturing follow of heat exchangers and steam generators for high pressure service. Degree required.

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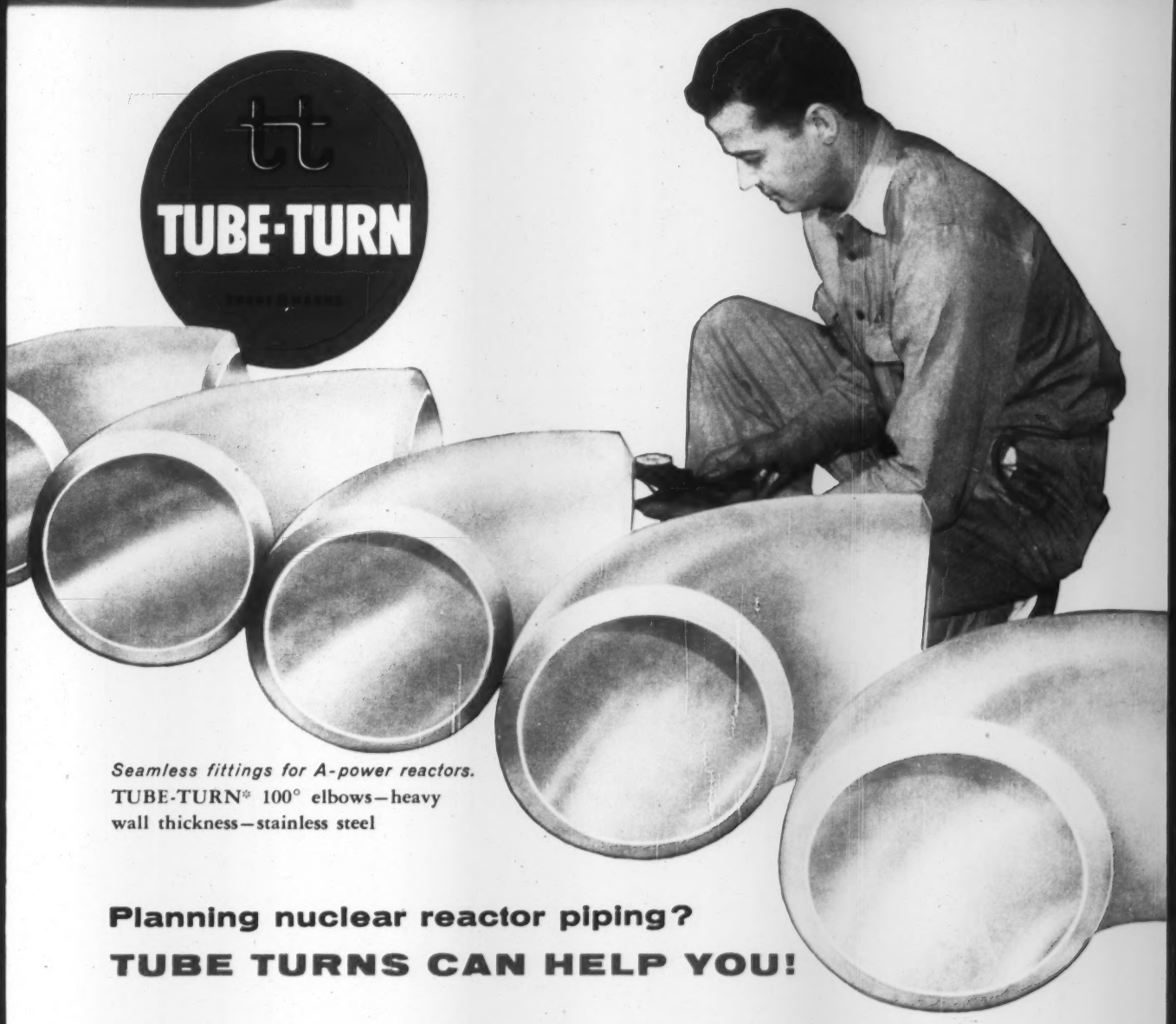
Experienced pumps, valves. Work as liaison between engineering department and vendors on centrifugal pumps and other semi-standard centrifugal and positive placement pumps and valves.

METALLURGICAL ENGINEERS

Responsible for materials and processes application to marine nuclear power plants.

Westinghouse
ELECTRIC CORP.



Seamless fittings for A-power reactors.
TUBE-TURN* 100° elbows—heavy wall thickness—stainless steel

Planning nuclear reactor piping?
TUBE TURNS CAN HELP YOU!

Since the origin of atomic energy projects, Tube Turns has been recognized as the leader in welding fittings for this fast-moving industry. Working with reactor builders, Tube Turns is now applying advanced techniques to the manufacture of seamless, forged fittings—in stainless steels, stainless-clad carbon steel, chrome-moly steels, aluminum and titanium.

Made to close tolerances and exacting specifications, these TUBE-TURN products are playing a vital part in industrial and government A-power projects.

For Tube Turns' engineering service on nuclear energy piping projects, call our nearest office.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS
LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

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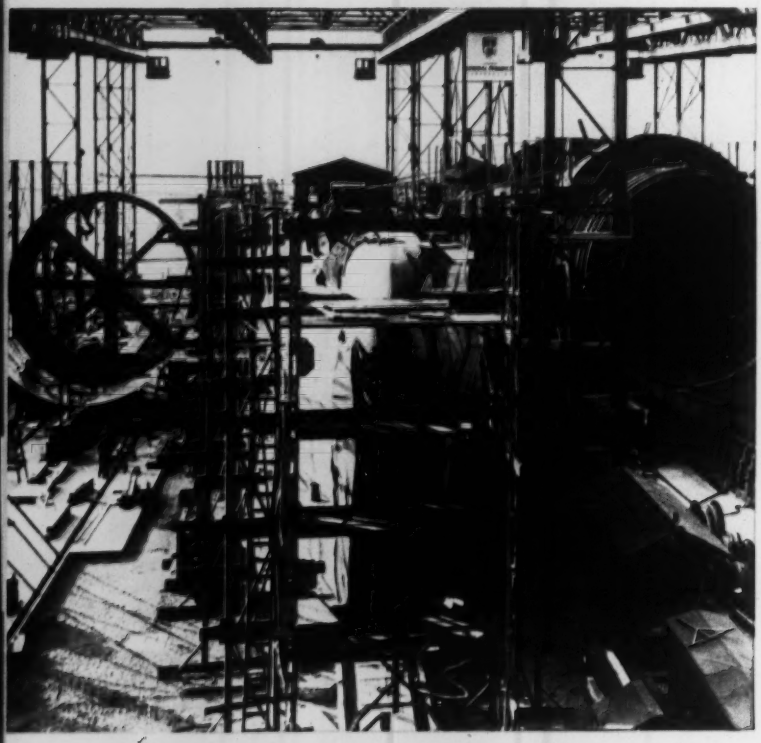
*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

MORE INFORMATION...

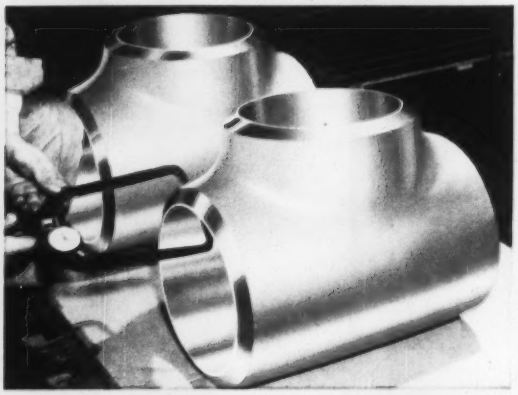
In the nuclear energy field...
as in all fields...

YOU GET TOP QUALITY
from TUBE TURNS!

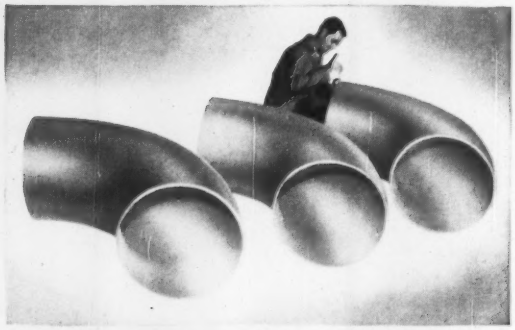


FASTEST AND LARGEST. TUBE-TURN* Welding Fittings will be used for coolant piping of the "Skipjack" (on left), and for all main coolant piping of two-reactor sub "Triton" (on right), the largest sub. These nuclear-powered submarines are shown on the ways at Electric Boat Division, General Dynamics Corp., Groton, Connecticut.

SEAMLESS STAINLESS CLAD . . . another Tube Turns' first. These heavy-wall 52° elbows for a pressurized water reactor are typical of Tube Turns' pioneering line of seamless stainless-clad carbon steel fittings.



STAINLESS STEEL. These TUBE-TURN stainless steel welding tees are for a two-reactor submarine.



ALUMINUM. These TUBE-TURN Aluminum Elbows are for nuclear swimming pool reactor water-coolant lines. Unsurpassed uniformity of wall thickness, circularity and curvature.

For consultation on nuclear power piping problems, call the nearest Tube Turns' office.

*"TUBE-TURN" and "TT" Reg. U. S. Pat. Off.

MAIL COUPON FOR INFORMATION

TUBE TURNS, Dept. F-3
224 East Broadway, Louisville 1, Kentucky

I have a reactor piping problem involving welding fitting and flange material checked. Please send information.

☐ Stainless-clad steel	☐ Copper	☐ Hastelloy
☐ Stainless steel	☐ Titanium	☐ Zirconium
☐ Aluminum	☐ Nickel alloys	☐ Chrome-moly steel

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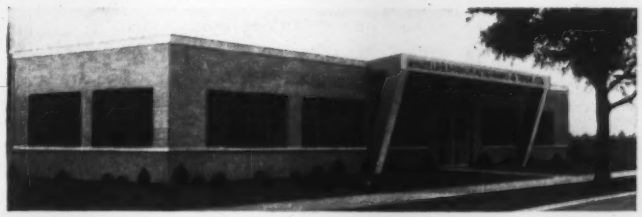
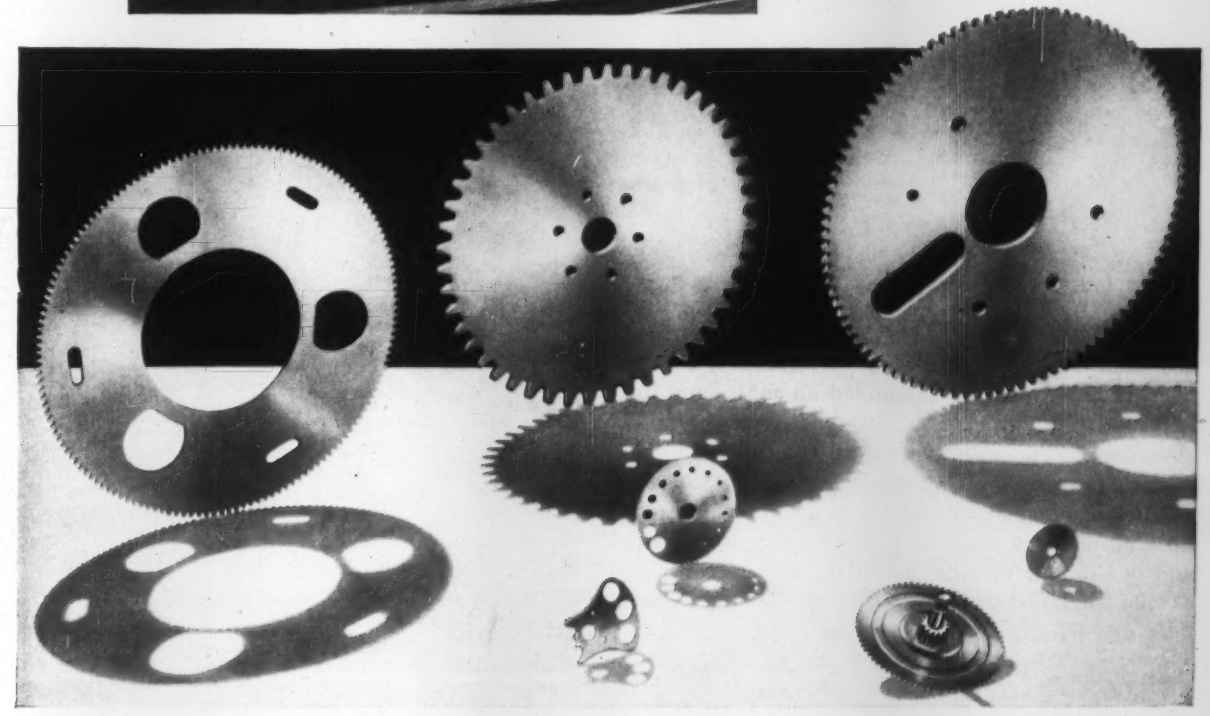
The Outstanding Success of Winzeler STAMPED Gearing Results from Vastly Improved Methods of Tooling, Stamping and Inspection



Winzeler accuracy and efficiency is now greater than ever in this brand new, specially designed, one-floor plant. Here, highly developed men, methods and machines keep pace with the rapidly increasing demand for the better Stamped Gearing we make.



WINZELER is now better equipped than ever to *Stamp* Gearing in production runs. Greatly enlarged, modernized plant, methods and equipment produce Gearing by the thousands or *millions* with a degree of speed and uniform accuracy generally considered impossible! Skilled WINZELER engineers can lend you valuable aid in determining the ONE best and most economical application for your specific needs.

WINZELER now *stamps* better Gearing from *8 to 120* dp . . from .006 to 3/16" thickness and up to 7 inch diameter. Single stampings are often laminated and indexed to produce wider faces at savings up to 60%! Now, BAKELITE Gearing is successfully stamped and shaved, with special tooling, from material up to 1/8" thick. Teeth are sharp, clean-cut, uniformly accurate. Join the fast-growing group of critical customers who improve quality, performance and profits by using WINZELER *Stamped* Gearing exclusively. Write us now about *your* needs.

WINZELER *Stamped Gears*

MAIL THE COUPON FOR FREE STAMPED GEAR FOLDER

WINZELER MANUFACTURING & TOOL CO.,
7355 W. WILSON AVENUE, CHICAGO 31, ILLINOIS

Gentlemen:

Please mail to me, at once, a copy of the free WINZELER Stamped Gear folder.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ ZONE___ STATE____

Hyatt's Simplified Fitting Practice for Bearing Races

HYATT pioneered the use of carburizing type alloys in order to obtain the advantages of heavier race fits

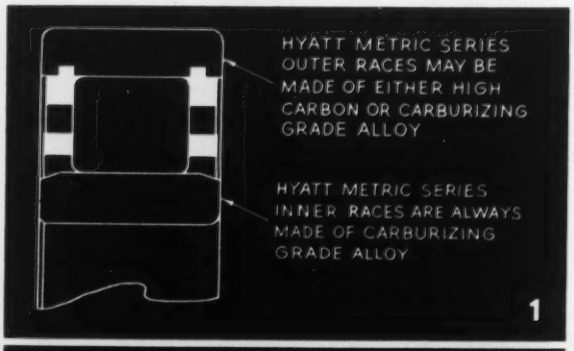
To obtain the best possible performance, roller bearing races must be assembled on shafts and in housings with certain fits developed by design and experience. The most frequent condition to be met is a rotating shaft where specific load and speed conditions must be satisfied with appropriate race fits. These vary according to the manufacturer, and in the case of some manufacturers, according to the application. Naturally, the fits will also vary according to bearing type and size.

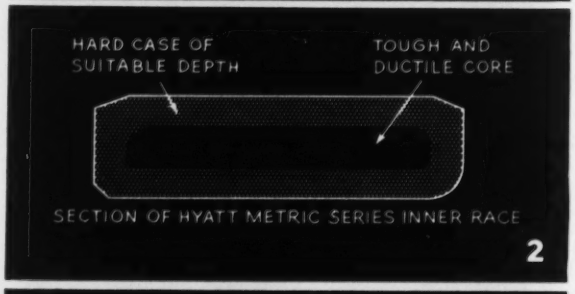
1. CARBURIZING PERMITS HEAVIER INTERFERENCE FITS

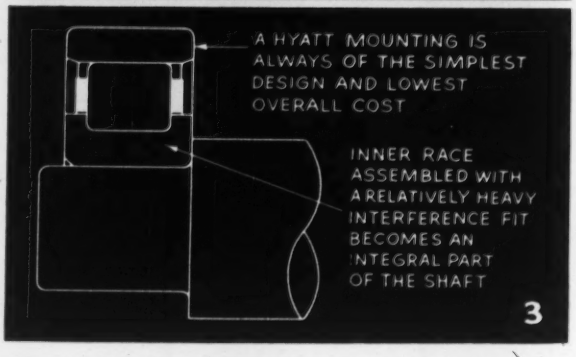
Taking the standard metric series of cylindrical roller bearings for an example, the bearing user has the choice of two fitting practices. One involves the use of inner races made of through-hardening steel, which dictates fairly light interference fits to avoid splitting. The other utilizes races made of low carbon steel *carburized* and hardened to develop a suitable surface hardness and a tough ductile core. The latter permits much heavier interference fits and has the additional advantage of eliminating all auxiliary holding devices, because the race becomes practically an integral part of the shaft. (Figs. 1, 2.)

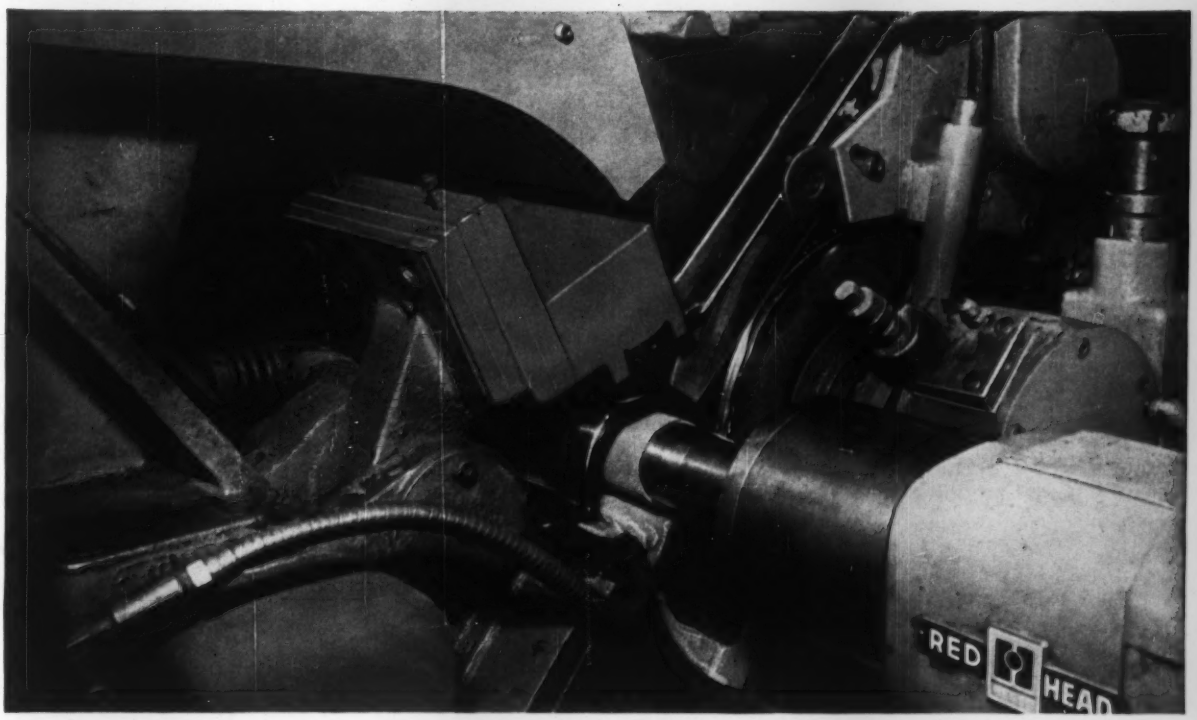
2. HEAVIER FITS SIMPLIFY MOUNTING, REDUCE COSTS

Hyatt originated the carburized race and the system of relatively heavy inner race fits to simplify bearing mounting and eliminate the need for retaining devices. Practically all HYATT inner races are made from nickel alloys of the carburizing type. They permit mountings of the simplest type and lowest over-all cost. Furthermore, the shoulders of HYATT carburized races will withstand considerably greater impact loads than will ordinary races. (Figures 3 and 4.)


HYATT METRIC SERIES OUTER RACES MAY BE MADE OF EITHER HIGH CARBON OR CARBURIZING GRADE ALLOY
HYATT METRIC SERIES INNER RACES ARE ALWAYS MADE OF CARBURIZING GRADE ALLOY
1




A HYATT MOUNTING IS ALWAYS OF THE SIMPLEST DESIGN AND LOWEST OVERALL COST
INNER RACE ASSEMBLED WITH A RELATIVELY HEAVY INTERFERENCE FIT BECOMES AN INTEGRAL PART OF THE SHAFT
3

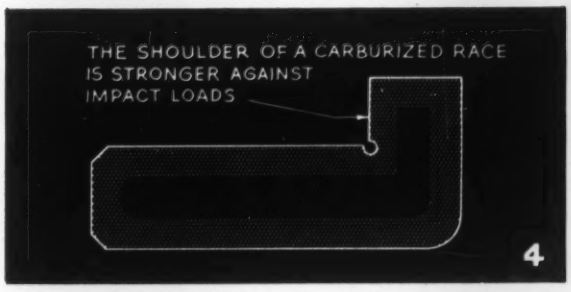


Hyatt inner race being centerless I. D. (inside diameter) ground to close tolerances.

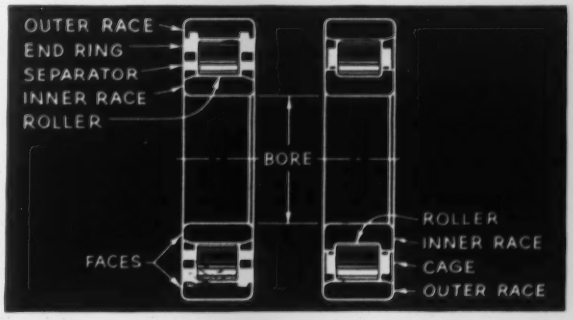
There are two fitting specifications which apply to HYATT inner races, depending on whether the inner race rotates or is stationary in operation. Remember, with both inner and outer race, the rotating member is assembled with heavier fit.

3. HYATT INNER RACES CAN BE EASILY SHRUNK ON SHAFTS

HYATT inner races may be mounted on shafts by pressing or shrinking. Where shrinking practice is employed, first heat the race in oil held at a temperature not over 300°F, or in an electric oven under a similarly controlled temperature, until it expands sufficiently to be slipped into position. The required interference fit will develop as the race cools in place. For special conditions of fit involving hollow shafts of varying sections or multiple housings of dissimilar metals, consult your HYATT Sales Engineer from our nearest sales office.



COMPONENT PARTS OF A HYATT ROLLER BEARING



YOU WILL FIND MORE DETAILS in HYATT Catalog No. 150. If you do not have a copy, write Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey. Sales offices at Harrison, Pittsburgh, Chicago, Detroit and Oakland, California.

HYATT HY-ROLL BEARINGS FOR MODERN INDUSTRY

GM GENERAL MOTORS

. . . Fluid Power news

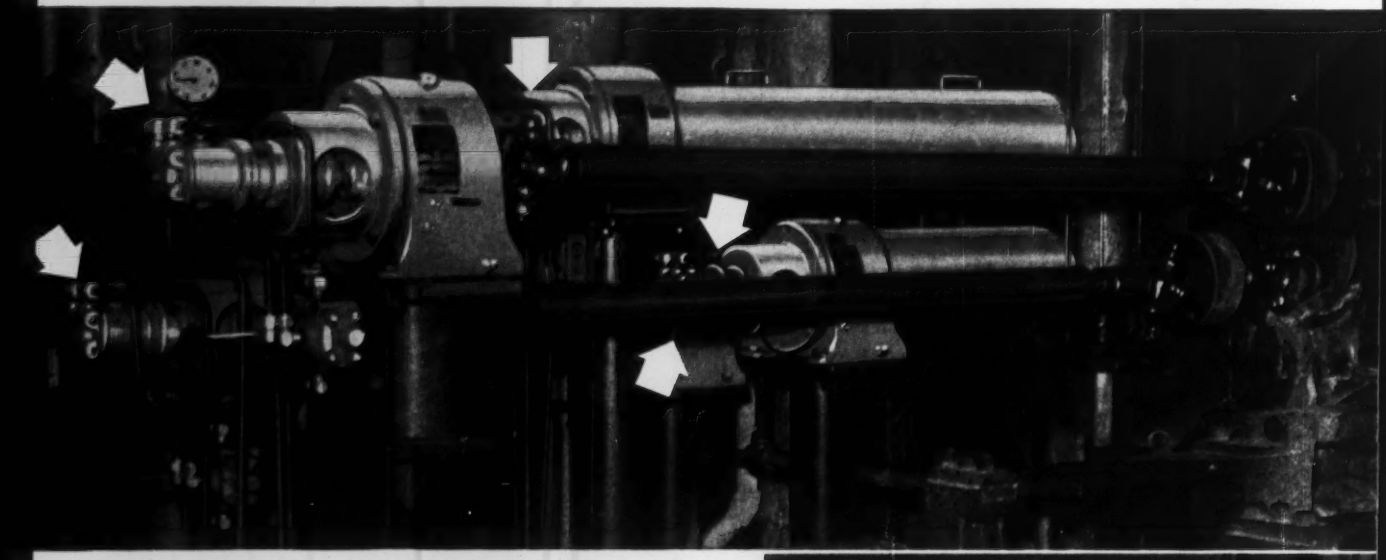
REPORT: No. 12,100 MOTOR TROUBLES SOLVED

From Oilgear Application-Engineering Files

HOW OILGEAR "ANY-SPEED" DRIVES ON PAPER MACHINE SOLVED MOTOR TROUBLES

CUSTOMER: *A Large Paper Company (Name withheld by request)*

DATA: For modernizing a paper machine installed in 1913, rebuilt in 1927. Five drives required for distributor rolls (1 rectifier roll, 2 head rectifier rolls, 2 slice box rectifier rolls) in head box on wet, or fourdrinier end, to spread wet paper pulp "blanket" on wire mesh for removal of water. Due to standard mill practice of daily equipment washdown with high pressure hoses, plus high humidity during operation, use of 5 electric, variable-speed drives would have resulted in excessive maintenance costs. Rotational reversal was desirable on the two slice box rectifier rolls. Must have smooth, steady, continuous slow-speed operation at full rated load. Roll synchronization within 10% allowable. Must be compact, easy to install, and maintain.



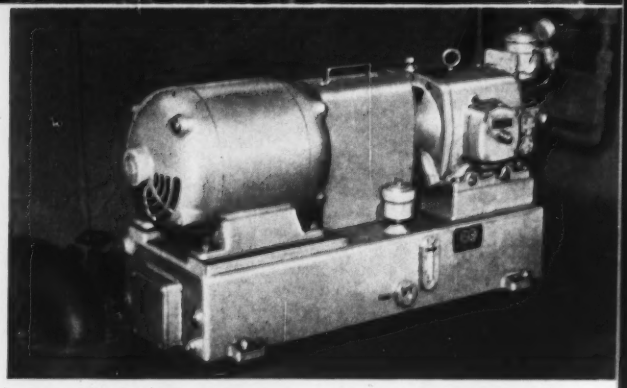
SOLUTION: Five "Oilgeareducers"—heavy-duty, constant torque, type "H" hydraulic motors integral with Falk Steel Reducers. As accurate roll synchronization was *not* required, motors were driven in parallel from a single Oilgear "DP" variable displacement pump. This pump has an automatic power-conserving control that reduces power input as load requirements diminish. Independent speed controls were installed for each drive. Two 4-way valves provide for instant, cushioned reversal required for two rolls. A completely sealed, compact, "Any-Speed" Fluid Power drive system . . . impervious to washdowns, automatically protected against overload, with full rated torque at any speed . . . to match any requirement. System is pressure and flood-lubricated automatically with the oil in the system. Over a year of continuous service—no maintenance required to date. Performance has proved superior to requested specifications and has made possible some improvements in paper structure.

For practical solutions to your linear or rotary drive problems, call the factory-trained, Oilgear application-engineer in your vicinity. Or write, stating your specific requirements directly to . . .

THE OILGEAR COMPANY

Application-Engineered Fluid Power Systems

1570 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN



Oilgear "DP" variable displacement pump with automatic power-conserving control, 10-hp electric motor, and reservoir shown mounted in basement below the paper machine away from danger of contamination.

This large producer of glassine and greaseproof papers, has also Oilgear-equipped the winder drive in their converting plant glue machine; the center winder drive on a super-calender stack; the unwind and rewind drives on another super-calender; plus many other mill applications.

"Engineers—we've achieved *SUSTAINED* supersonic flight...!"

"As Chief Test Pilot at Convair-Fort Worth, I've flown initial and subsequent tests on several of the outstanding aircraft created by Convair's design and engineering teams. Surpassing all, however, is their newest and most significant achievement, the Convair B-58 . . . built for the U. S. Air Force.

"The Convair B-58 is a completely integrated aerial weapon system. As America's first supersonic bomber, the B-58 has the capacity for *sustained* supersonic flight which represents a performance breakthrough vital to American military aviation. Such an accomplishment reflects the ability of Convair engineers and scientists to think far beyond conventional ideas of design and performance."

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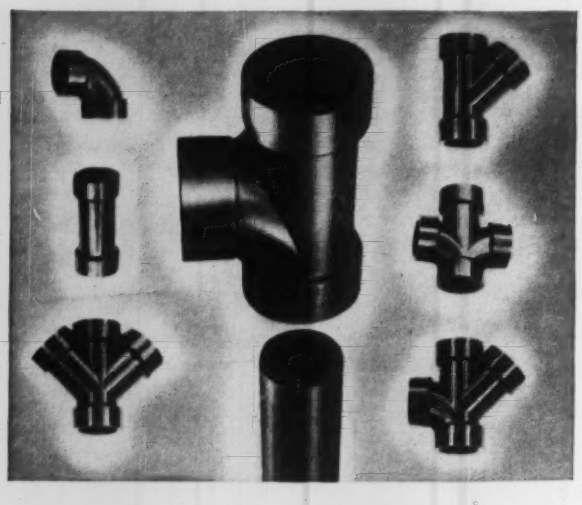
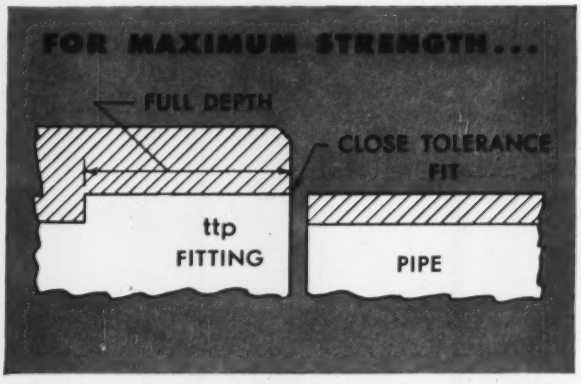
Write *today* in confidence to: MR. H. A. BODLEY, *Engineering Personnel*

CONVAIR IS A DIVISION OF GENERAL DYNAMICS CORPORATION

PVC PIPING NEWS

PUBLISHED BY TUBE TURNS PLASTICS, INC. • LOUISVILLE 1, KENTUCKY





New drainage fittings offer big savings

Tube Turns Plastics announces a new line of PVC drainage fittings for carrying away corrosive waste liquids. Compared to cast alloys normally used, they cut labor and materials costs drastically. Can make solvent-cemented joints in about ¼ usual time. Available in all standard types . . . sizes 1½" through 4".

Extensive tests prove superiority of ttp solvent-cemented joints

Tube Turns Plastics has completed thousands of tests to show how maximum strength and joint-cementing speed are assured with **ttp** socket type fittings and solvent cement. Findings:

1. Full-Depth Socket. Strength of any PVC solvent-cemented joint depends on *area of contact*. Tube Turns Plastics was the first company to offer a complete line of socket-cemented PVC fittings having full depth of sockets providing areas of contact such that the joints are stronger than the fittings or pipe of same rating, when easily learned cementing technique is properly employed.

2. Socket bore tolerances are designed to avoid "interference fit" with pipe as normally made, yet provide more than adequate joint strength. Slowing down of joint making is thus minimized and overstressing fitting is avoided.

3. Close-Tolerance Fit. I.D. of fitting matches O.D. of pipe as closely as possible to provide 100% joint efficiency with normal tolerances of pipe. "Interference fit" not desirable with PVC.

4. Strongest joints secured with **ttp** solvent cement, proven by leading users of PVC piping. This cement is *pure PVC* in solvent.

The full line...nearby

Your Tube Turns Plastics' Distributor can deliver promptly from the complete line of **ttp** injection molded fittings, flanges and valves . . . in sizes ½" through 4". . . threaded and socket type . . . normal and high impact PVC . . . as well as solvent cement and thread lubricant. This one source can meet *all* of your requirements. Write for Bulletin TTP 119.

Leading Manufacturer of Injection Molded Polyvinyl Chloride Pipe Fittings, Flanges and Valves

TUBE TURNS PLASTICS, INC.

Dept. TTP-6, 2929 Magazine St. • Louisville 11, Kentucky

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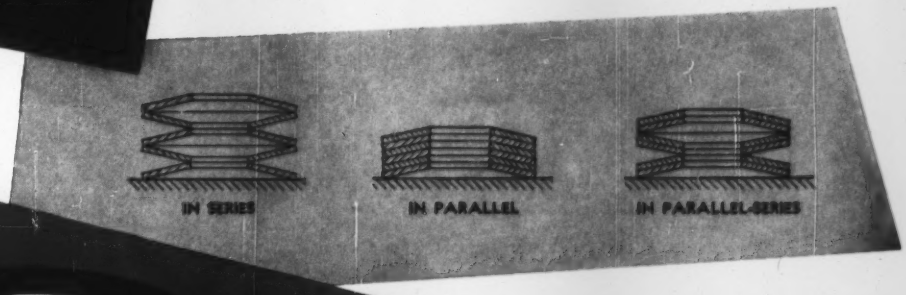
.025 THICK STEEL
10 WASHERS IN SERIES
35 LBS. AT .250 DEFLECTION

This useful type of spring may be the answer to your need where space and load requirements are a problem. Made to any diameter or thickness—can be stacked in series, parallel, or parallel-series, or as an "Energy* Cartridge." The experience of our engineers is available in a pamphlet, "Belleville Washers." Write for your copy.



.125 THICK STEEL

4 WASHERS IN PARALLEL

8000 LBS. AT .025 DEFLECTION

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*Patented

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RAYMOND Manufacturing COMPANY, CORRY, PENNSYLVANIA

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THE WALLACE BARNES CO., LTD., HAMILTON CANADA

Divisions of

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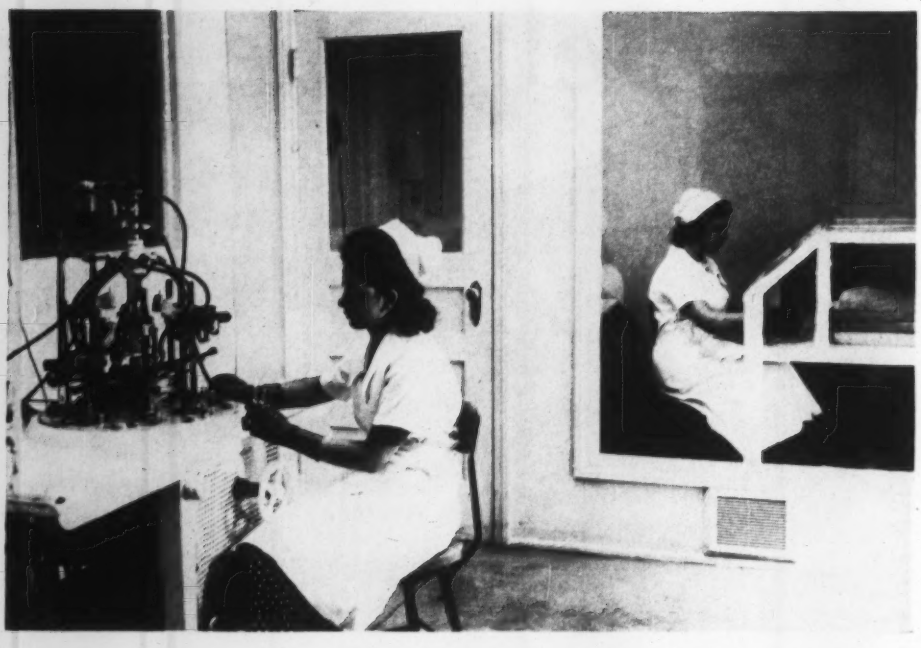
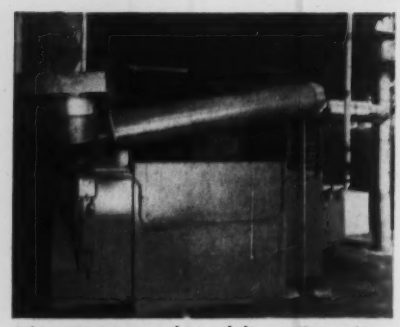
GENERAL OFFICES: BRISTOL, CONNECTICUT



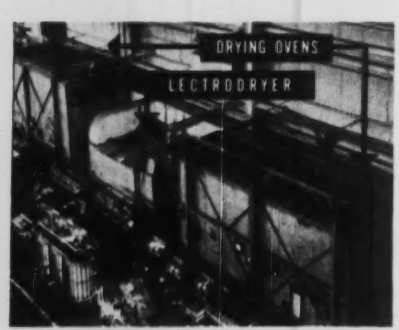
Ampoules are filled in DRY *box at right and sealed in near room, held at 10% relative humidity by a Type CH Lectrodryer.*

Are you just living with your moisture problems?

Lectrodryer can relieve those worries*



This CHO Lectrodryer delivers DRY *air on a continuous basis, 14 hours per day, to a sugar conveyor system in a candy factory.*



*Transformer production was more than doubled—*DRYing *time reduced from 92 to 32 hours—when a manufacturer fed* DRY *air to these ovens.*

MOISTURE gums-up materials in storage—makes handling difficult and destroys them. Processes are slowed down and even stopped. Recognize that unwanted moisture is causing your troubles and you've gone a long way toward eliminating them.

Maintaining DRYness in dry boxes where pharmaceuticals are packaged or electronic equipment assembled presents little difficulty. In workrooms containing dozens of workers, however, you must compensate for moisture they exude, as well as leakage through walls and doorways.

Lectrodryer engineers have been solving such problems for years—advising on methods of insulating areas against moisture infiltration, then supplying controls and DRYing machines to hold humidity down.

The book, *Because Moisture Isn't Pink,* tells how others have solved their problems. For a copy, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 335 32nd St., Pittsburgh 30, Pennsylvania.

In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

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*REGISTERED TRADEMARK U. S. PAT. OFF.

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CHEMICAL PLANTS • POWER PLANTS

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MOST WANTED — that's right — because the G P line includes gate, globe, and angle type valves having seats faced with **HAYNES STELLITE*** alloy or other hard facing alloys for greater seat-wear resistance . . . at no extra cost!

Hard faced seats, in combination with precision finished, selectively hardened discs and wedges give these valves amazing resistance to erosion, corrosion and galling. That's why they are setting new standards of performance in steam, water, oil, or gas services at the recommended pressures and temperatures.

Get longer, drop-tight, service life with minimum maintenance by specifying Vogt G P Valves. Available in a complete range of sizes from 1/4" to 2" and rated 800 pounds at 850°F. and 2000 pounds at 100°F.

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DROP FORGED STEEL

VALVES

*Trade-Mark of Union Carbide and Carbon Corporation

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"The American competitive enterprise system was founded on the work and savings of the people and has produced the highest standard of living in history.

"Our people of their own free will have made all forms of investment from Government Savings Bonds to venture capital for new enterprise. Competitive enterprise is dependent on the continued supply of these funds, which benefit consumers, workers, and the national interest.

"Investing in America through Savings Bonds and venture capital has helped make our country great and this idea needs to be brought home to all the people."

T. S. PETERSEN, *President,*
Standard Oil Company of California.

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Put the Badger Man on the Spot!

Complex expansion joint problems are *best* analyzed at only one place: your office or plant site. It's there alone — where the figuring is going on — that *all* essential data about your proposed installation is available.

And it's there — *on the spot* — that the Badger Man can assist you. Because 1. he is a trained engineer; 2. he brings to your problem the background of the world's most experienced manufacturer of expansion joints.*

Next time you are confronted with a complicated piping layout, severe operating conditions, unusual size and shape requirements — *any* complex expansion joint problem — put the Badger Man on the spot! His services are as close as your telephone.

COMING SOON — Badger Service-Rated Expansion Joints. Incorporate revolutionary new features developed during three years of intensive research and testing. Watch for this important announcement.

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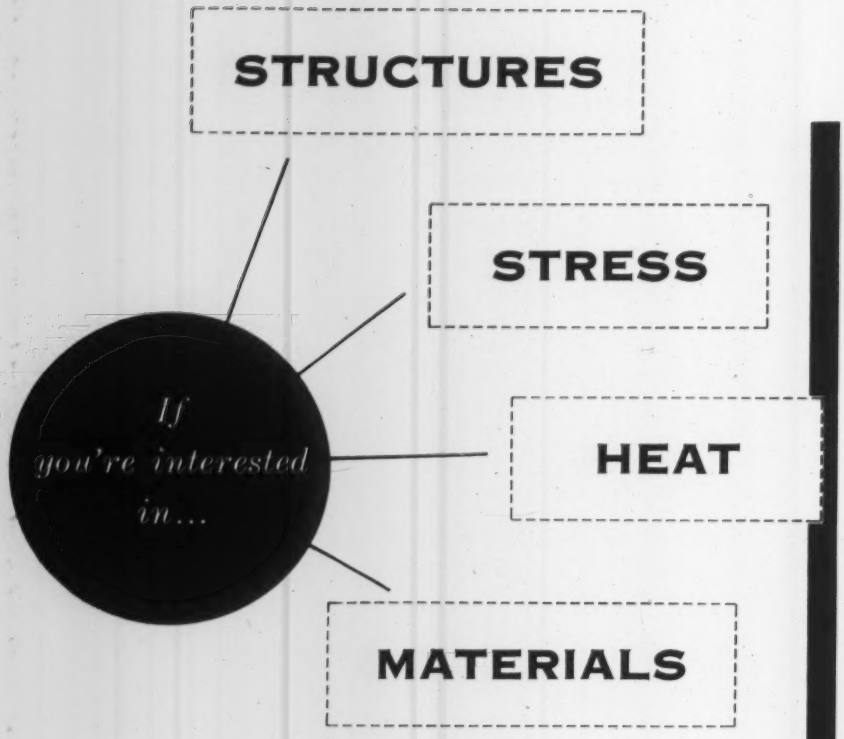
*Badger has been solving tough expansion joint problems for 50 years — a record unmatched by any other firm.



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There are many excellent openings for mechanical and aeronautical engineers for challenging assignments in the areas of high-speed missiles, aircraft structures, and antennas. This work concerns developing practical solutions to both theoretical and actual problems of heat transfer, structural analysis and design, stress analysis, materials section, and instrumentation.

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For aerodynamics consultation. Determination of aerodynamic loads for modifications to aircraft. Additional aeronautical engineering tasks such as stress, mechanical engineering, hydraulics, etc.

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These positions also available in the Research and Development activity at Tucson, Arizona.

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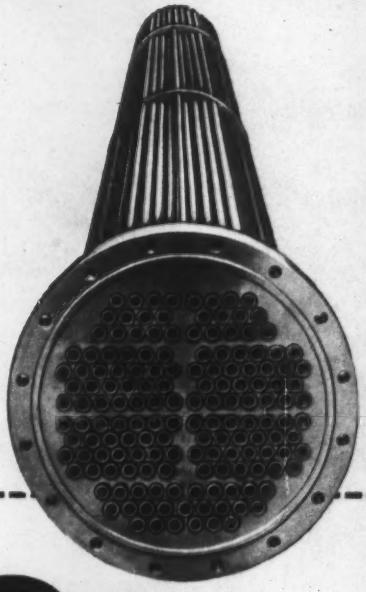
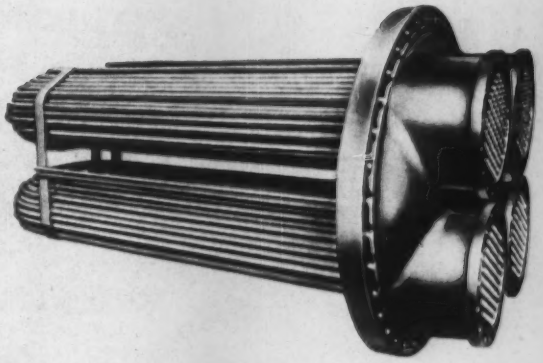
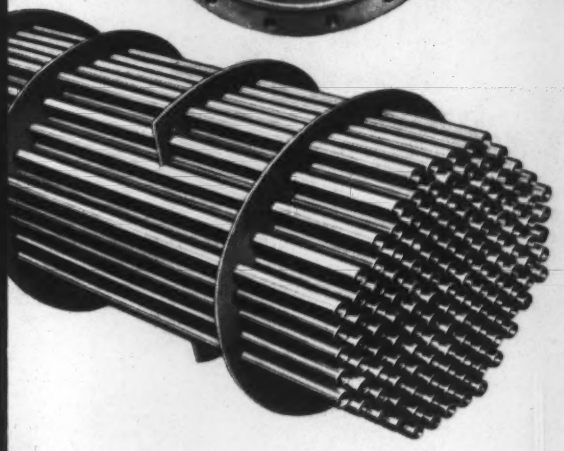
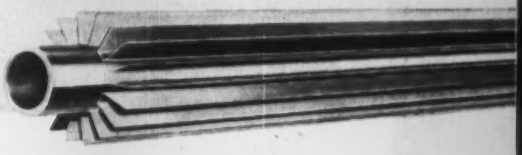




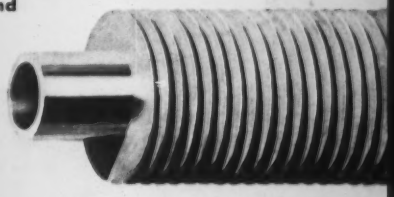


TWO GOOD WAYS TO ADD ADDITIONAL HEAT TRANSFER SURFACE AREA TO B&W CARBON STEEL ERW TUBES



(A) Longitudinal Channels Welded On

(B) Continuous Helical Fin Wound Around Tube and Welded On



TUBING REQUIREMENTS FOR HEAT TRANSFER EQUIPMENT

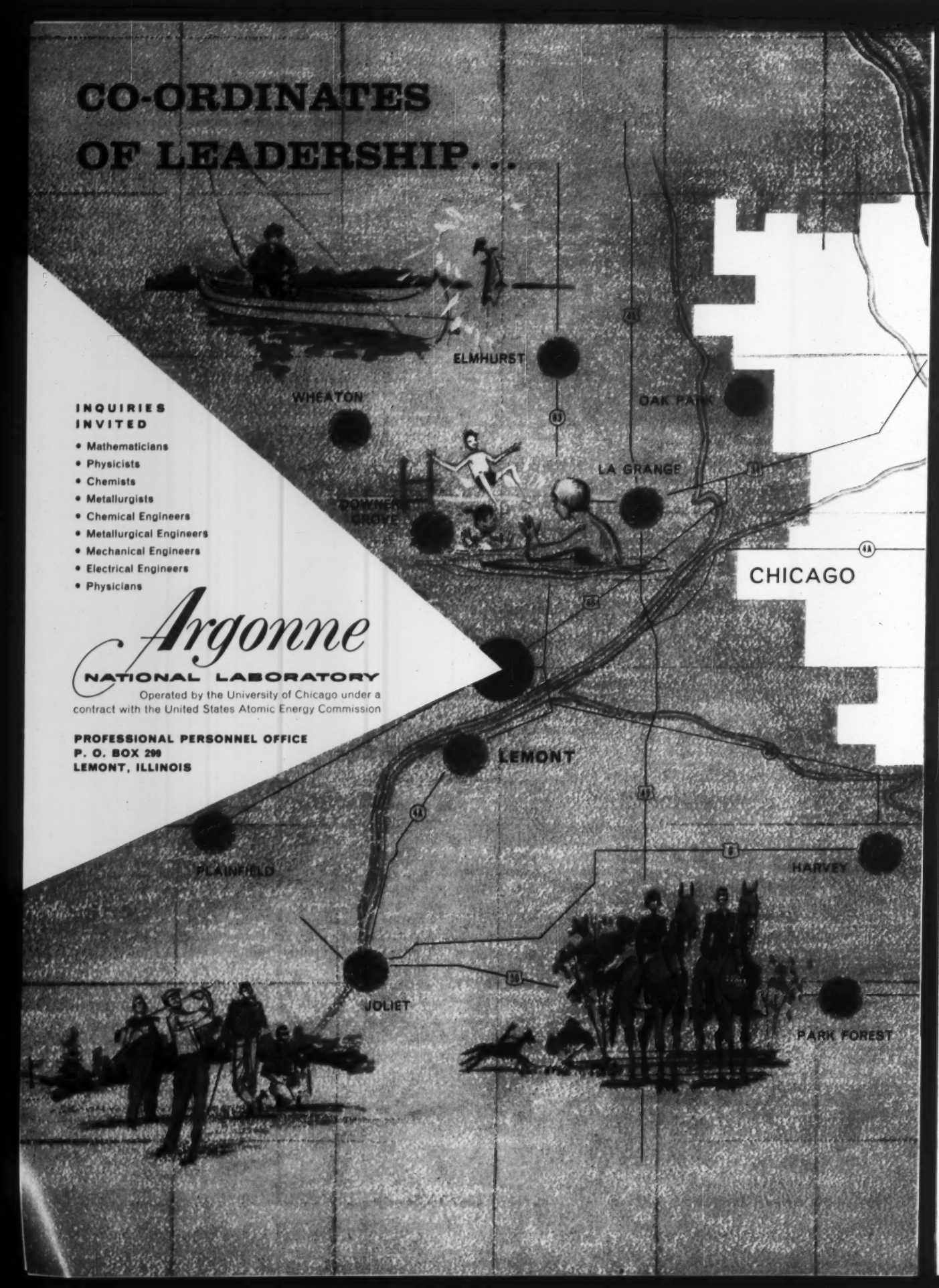
The economy and usefulness of pressure tubing in heat exchanger and condenser applications depend on the tubing's heat transfer ability and the ease with which it can be bent, coiled, swaged, and rolled into tube sheets.

Because of its uniform wall thickness, the heat transfer ability of B&W Electric-Resistance-Welded Carbon Steel Tubing is the optimum for such a ferrous material. It is an economical material to use, not only because of its reasonable first cost, but also because of its low fabrication cost, since ease of bending, coiling, swaging, and rolling into tube sheets is provided through quality-controlled methods used in its manufacture.

B&W Electric-Resistance-Welded Carbon Steel Heat Exchanger and Condenser Tubing is widely used in the process industries, including petroleum refining and chemical processing, and in refrigeration and steam generating equipment. If carbon steel tubing can do the job required, you will find B&W ERW Tubing provides maximum, trouble-free service life. For additional information, call on Mr. Tubes, your nearby B&W Tube Representative — *or write for Bulletin 412.* The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pa.

TA 6099 PG-2

Seamless and welded tubular products, seamless welding fittings and forged steel flanges—in carbon, alloy, and stainless steels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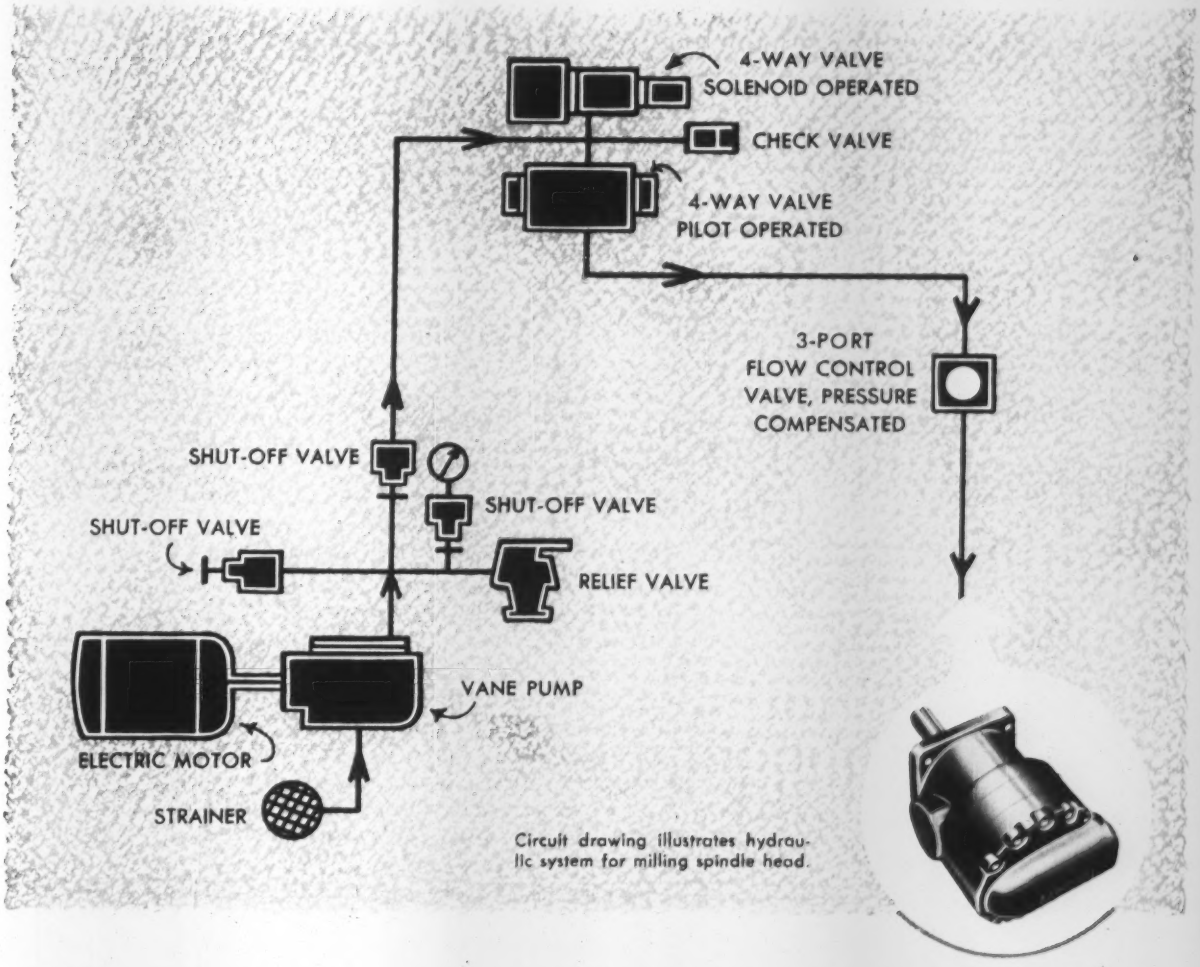


Circuit drawing illustrates hydraulic system for milling spindle head.

Developing a compact, efficient spindle head

...another application for Denison hydraulic power

Denison hydraulic motor is mounted directly to gear case of spindle and powers driver gear of the gear train.

THE PROBLEM: to develop a compact, efficient milling spindle head with infinitely variable spindle speed and instantaneous speed selection.

For True-Trace Sales Corporation of El Monte, California, the solution involved the use of hydraulic power... and Denison hydraulic equipment.

The result was spindle with a 15 hp rating and speeds up to 3000 RPM. To drive the spindle, True-Trace selected a Denison TMC-3 fluid motor. Variable speed control is achieved with a Denison 3-port flow control valve. The control's nine separate ranges permit exact speed selection by the operator.

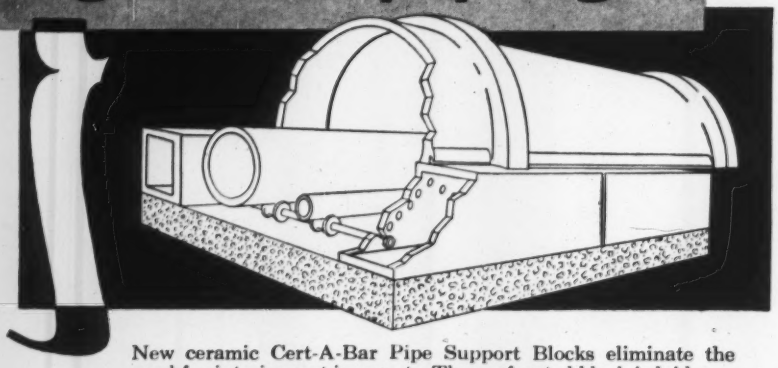
Let a Denison hydraulic specialist help you with your design problems. Write Denison Engineering Division, American Brake Shoe Co., 1174 Dublin Road, Columbus 16, Ohio.

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DENISON HydrOILics

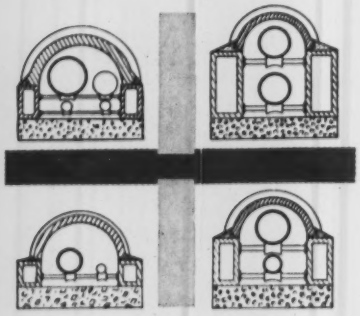
PERMANENT PROTECTION
for underground piping!

STILLWATER CERT-A-BAR* TUNNEL CONDUIT SYSTEM



New ceramic Cert-A-Bar Pipe Support Blocks eliminate the need for interior cast iron rests. The perforated block is laid as a structural support member at regular intervals, and the bars are simply inserted and locked in place.

THE vital consideration in selecting an underground conduit system is *permanent* protection . . . not for one year or five, *but for the life of the piping.* You get the best possible protection for your underground metal service piping with a Stillwater Conduit System of vitrified clay. It's chemically inert—can't rust, rot, corrode, or decay . . . ever. And it is manufactured in accordance with ASTM specification C-13-54, assuring proper strength and quality. Any combination of service piping can be protected. Conduit is available in a wide range of sizes, with a complete line of fittings and accessories, including alignment guides, lateral guides, and anchors. Any contractor's crew can handle the installation easily, or if you prefer, Stillwater Licensed Installers will assume the responsibility. The Cert-A-Bar Tunnel System can be installed with any of three suggested new waterproofing specifications —one for average conditions, one for intermittent ground water conditions, and a third for high water table conditions. It's the lowest-cost conduit per year of service that you can specify or install!



THE CERT-A-BAR SYSTEM HAS ALL THESE IMPORTANT ADVANTAGES

- Inherent structural strength for permanent protection
- Complete flexibility for design
- Minimum initial and long-term costs
- Quickly installed
- Keeps pipe insulation dry
- No electrolytic corrosion of piping
- No maintenance required

A few of the hundreds of possible combinations of piping for the Cert-A-Bar Tunnel System are shown at left.

WRITE FOR

illustrated, four-page circular with complete installation specifications.

*T.M. Reg. App. For. Patents Pending

The Stillwater Clay Products Co.
STILLWATER CONDUIT DIVISION
3334B Prospect Ave., Cleveland 15, Ohio

STILLWATER CONDUIT SYSTEMS

An Inside Peek at Steam Trap Capacity Ratings

or . . . how to be sure steam heated equipment is going to work the way it's engineered

WHEN YOU GET all through engineering a steam heated process equipment installation, its performance will depend on whether your steam traps will do what the catalog said.

Now, in theory, if you know the size of a steam trap orifice, you can figure how much water can be pushed through it in a given time by a given steam pressure. But, in practice, this doesn't work out. The picture is scrambled by things like the choking effect of flash steam and restriction of flow through the trap and piping.

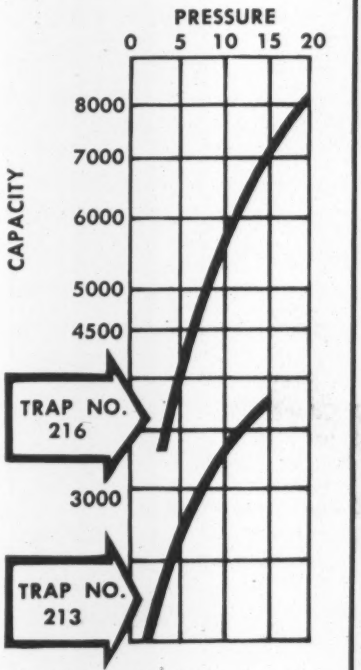


Fig. 1—Showing difference in volume of condensate discharged by a No. 216 trap with 2" pipe connections and a No. 213 trap with ¾" pipe connections—each trap having ½" discharge orifice.

For example, Fig. 1 shows that a ½" orifice in a 125 psi No. 216 Armstrong steam trap with 2" pipe connections will discharge 7200 lb/hr condensate at 15 psi inlet pressure. Yet, a ½" orifice in a 15 psi No. 213 trap with ¾" pipe connections, discharges but 3900 lb/hr at 15 psi inlet pressure. The difference: pipe friction.

Thus, we see a need for investigating the basis for steam trap capacity ratings. Unfortunately, they are not all arrived at in the same way. If they are based on cold water tests, producing no flash steam, they are much too high. Orifice tests are also too high because they ignore pipe friction. Calculations involving flow-through-orifice formulae have never been known to be conservative insofar as traps are concerned.

Armstrong Ratings

Armstrong trap capacity ratings are based on actual operating conditions, determined by hundreds of tests. In these tests condensate at the steam temperature corresponding to test pressure was used. Restriction of flow caused by the choking effect of flash steam, as well as the back pressure created by flash steam and condensate, automatically were taken into account. Actual installation hookups were used, so that pipe friction in both inlet and discharge lines also was reflected in the results.

All this effort assures you the nice, comfortable feeling that comes from knowing a trap will deliver on the job the full capacity claimed in the catalog.

* * *

There is one more ingredient that needs to be tossed into the trap-sizing pot. This morsel is the safety factor—the required excess of trap capacity over calculated condensate load. It will be the subject of the next advertisement in this series. But, in the meantime, if you'd like to get the lowdown, ask for a copy of the 44-page Armstrong Steam Trap Book. It is a complete guide to good trapping practice. It covers not only safety factors, but calculation of condensate loads and trap selection installation, troubleshooting and maintenance. Just call your local Armstrong Factory Representative, or write: **Armstrong Machine Works, 8943 Maple St., Three Rivers, Michigan.**

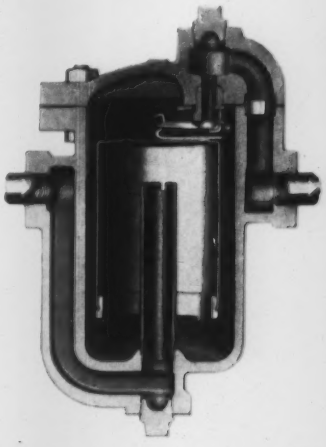


Fig. 2—Armstrong inverted bucket steam trap—hardened chrome steel valve and seat—stainless steel lever and bucket—simple, dependable, long-lived.

ARMSTRONG STEAM TRAPS

To **engineers** whose creative energies are being cramped by routine duties...

DOUGLAS GIVES YOU PLENTY OF "ELBOW ROOM" TO USE YOUR FULL TALENTS!

Become a part of a crack engineering team building for tomorrow... yet enjoying the rewards of accomplishment today. If you're tired of the routine, let your creative energies express themselves at Douglas. Whatever your engineering field, you will assure yourself a rewarding career by taking advantage of the many opportunities Douglas offers, such as...

KEY OPENINGS FOR THERMODYNAMICISTS!

Mechanical Engineers work on all phases of analysis, design and installation of equipment involved in heating, cooling and air distribution at high speeds.

For important career opportunities in your field, write:

C. C. LaVENE
DOUGLAS AIRCRAFT COMPANY, BOX K-620
SANTA MONICA, CALIFORNIA

Go further with **DOUGLAS**

FIRST IN AVIATION

10,000 LBS. OF POWER

for even ordinary lubrication jobs!

FAST, EFFICIENT HEAVY-DUTY ALEMITE HAND GUNS

This rugged Alemite lever-type gun is packed with power and superior features for super performance in industrial lubrication! Develops 10,000 lbs. pressure . . . more than enough for ordinary lubrication jobs—with plenty of reserve power for "tight" bearings! Handles all regular pressure gun greases. Long-operating handle for maximum leverage. Loader fitting permits fast, clean filling (or gun may be filled by suction). Capacity, 1 lb., outlet, ⅛" p.t.

Linkage is heavy steel for true piston alignment!

Follower rod disappears after filling—for ease of handling!

Heavy-duty Lever Gun Model 1056-SE

Loader fitting for fast clean filling with loader pump. No mess—no waste—no air pockets!

Complete line of adapters and hose for all types of fittings!

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Division of STEWART-WARNER CORPORATION

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Chicago 14, Illinois

Please send me your complete catalog on Alemite lubrication equipment for industry.

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City ..... Zone ..... State .....

STOP WISHING . . . START GROWING

. . . we think the right job for you is here at Western Electric

What do we mean by "the right job?" Well, mostly we mean there's a bonafide chance for you to *grow* at Western Electric.

It figures . . . in both the work we do and the status of the engineer in our company. Fully 55% of the college graduates in Western Electric's upper level of management have engineering degrees.

Keep in mind, too, that we follow a policy of promotion from within. And present indications are that at least *8,000* of our people will be promoted to management jobs in the next ten years.

Now, about our work. The wide range of functions at Western Electric includes production, merchandising, purchasing, installation and other aspects of the overall job. To make their technical work effective, many engineers participate in these broad managerial functions.

To keep pace with the ever increasing demand for more and better telephone service there's a constant need here for new products, new processes, new ideas. And for young engineers and scientists to help with the job.

Perhaps you'd work in the exciting world of transistors . . . automation . . . electronic switching . . . printed circuitry or one of our many other fields with a future. Or you might help with one of the defense contracts the government has asked us to take over – major projects like SAGE, the continental air defense system, the DEW Line arctic radar network, the Nike guided missile system–to which Western Electric engineering has made indispensable contributions.

Whatever your assignment with us – whatever your field–you'd be encouraged to move to positions of increasing responsibilities and rewards . . . to *grow*. A full-time graduate engineering education program is given new engineers during working hours to aid them to more easily assume a full engineering role in the company. Also, a tuition refund plan is provided for out-of-hours study at nearby colleges at company expense.

Certainly you'll want to learn of the specific opportunities available to you. To apply, send resume of your education and experience to Engineering Personnel, Room 1063, Western Electric Co., 195 Broadway, New York 7, N. Y. In confidence, if you wish.

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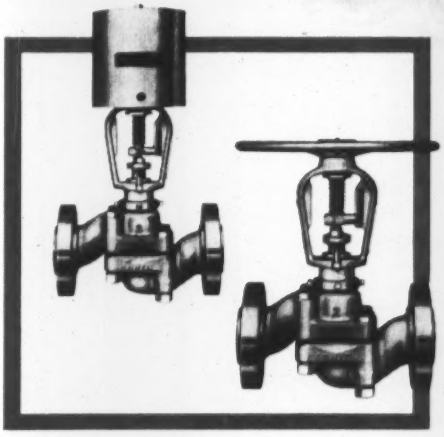
MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

Manufacturing plants in Chicago, Ill.; Kearny, N. J.; Baltimore, Md.; Indianapolis, Ind.; Allentown and Laureldale, Pa.; Burlington, Greensboro and Winston-Salem, N. C.; Buffalo, N. Y.; North Andover, Mass.; Lincoln and Omaha, Neb.; St. Paul and Duluth, Minn. Distributing Centers in 30 cities and Installation headquarters in 16 cities. Also, Teletype Corporation, Chicago 14, Illinois.

TOP HAND

...where Management
...Production and
Maintenance
are concerned!



ANNIN VALVES *meet every test of reliability, response and easy maintenance at low cost*

ANNIN VALVES are the only valves that meet the rigorous requirements of the missile program and the exacting demands of the modern process industries in a single standard construction at no premium.

- **MANAGEMENT** prefers Annin Valves because of low initial cost and low maintenance and spare parts inventory.
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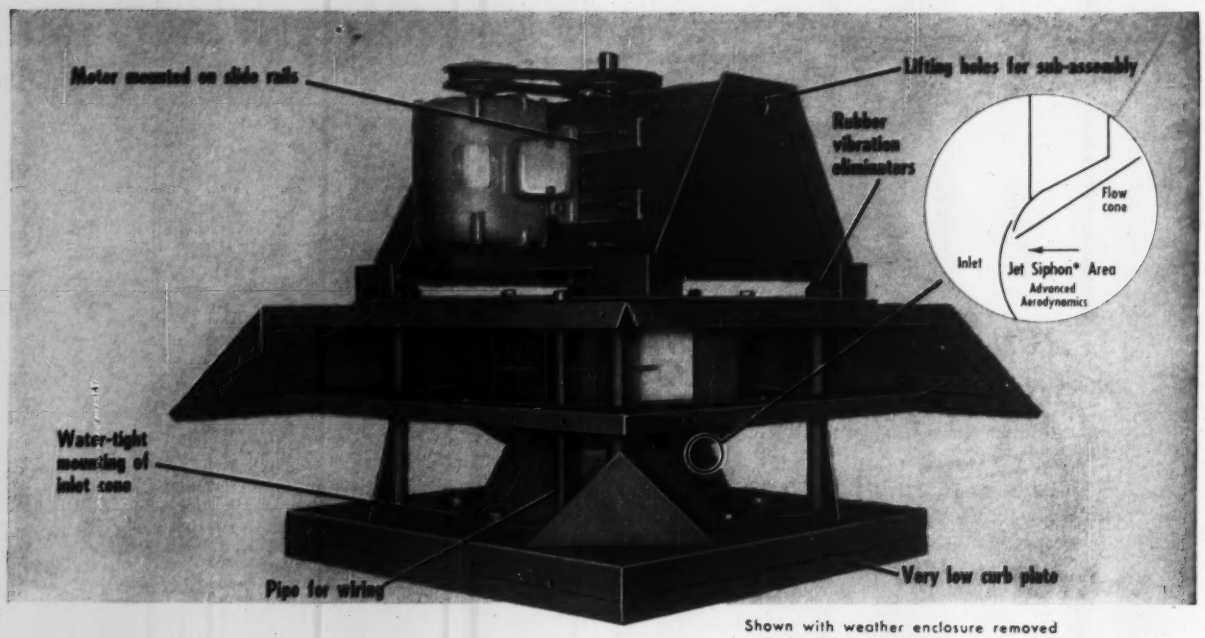
ANNIN *Control* **VALVES**

THE ANNIN COMPANY
DIVISION OF THE ANNIN CORPORATION
6570 Telegraph Road, Los Angeles 22, California



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PLUS VALUES... all yours in the Clarage Centrilator

POWER ROOF VENTILATOR — CENTRIFUGAL TYPE

Jet Siphon* feature for stable, high efficiency.

Static pressures to 2" — thus well suited to both light-duty installations without ductwork and applications where ductwork or hoods impose considerable resistance.

Adaptable to a wide range of motor sizes.

Variable pitch V-belt drive.

Wheel and inlet designed for streamlined air flow.

Built heavy-duty throughout to assure long-lasting, trouble-free service.

Every wheel statically and dynamically balanced on precision machines.

Inspection panel and complete accessibility.

Low overall height.

Venting of motor and drive area.

Engineered and constructed for extra quietness.

Heavy-duty anti-friction bearings.

Simple installation — only 4 bolts required.

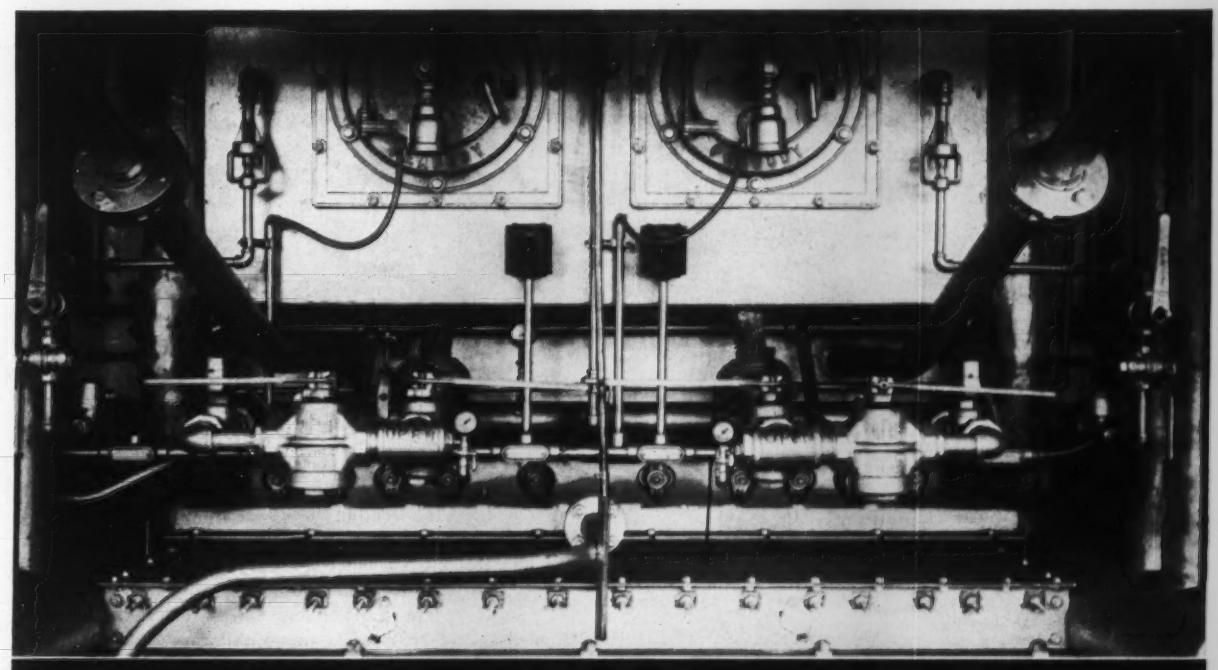
Write today for Bulletin 550. Clarage Fan Co., Kalamazoo, Mich.

CLARAGE

*Patent applied for

...dependable equipment for making air your servant

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



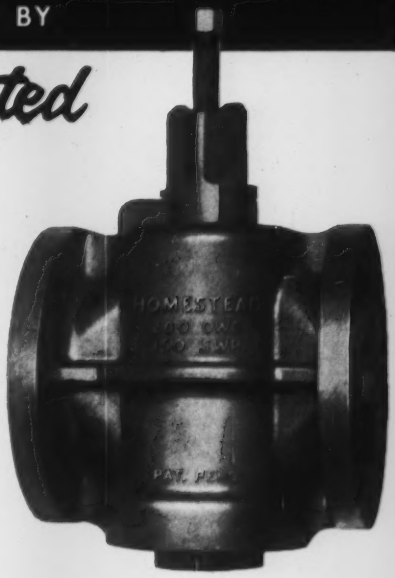
controlling gas to furnaces and boilers...

AN IMPORTANT JOB DONE BY

HOMESTEAD *lubricated* PLUG VALVES

AT A. B. DICK COMPANY, CHICAGO

An analysis of numerous types of valves convinced the A. B. Dick Company that HOMESTEAD Lubricated PLUG VALVES were well suited for use on gas lines to furnaces and boilers in their Chicago, Illinois plant. In fact, there are more than 5,000 Homestead Valves of various types in this plant. Satisfactory performance from the valves they have chosen is guaranteed by built-in features such as:



1. 100% Pipe Area—streamlined ports—minimum resistance to flow —minimum pressure drop.
2. Controlled Pressurized Lubricant System prevents sticking, by instant piston-like movement of plug at start of lubrication.
3. Extruded lubricant around stem indicates system is full; serves as stop signal to prevent overlubrication. No clogging of low pressure lines with lubricant, fouling of meters, orifices, etc.
4. Triple Head Seal—two rings of lubricant and reinforced Teflon stem seal. Stem seal holds pressure even without lubrication.

. . . plus many others. To know the meaning of real valve economy and service, install a few of these valves under your own service conditions. You'll be glad you did.

Your copy of Valve Reference Book No. 39-5 showing Homestead Lubricated Plug Valves will be sent on request.

Please mail, without obligation,
Valve Reference Book
No. 39—Section 5.

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P. O. BOX 38 *"Serving Since 1892"* CORAOPOLIS, PA.

How to make the most of your engineering career
ONE OF A SERIES

get into an industry that's on its way up

Job stability is important to your future. So is security. Your work loses its sparkle if you're worried about next year. Or the year after.

Where do you find security? In an industry that's on its way up. And in a company that has a limitless future before it.

To cite just one example: Boeing is expanding so steadily that today it employs 400% more engineers and scientists than 10 years ago. Contracts for commercial jet transports, intercontinental jet bombers and military jet transport-tankers extend far into the future. New plants are abuilding—including a vast one for producing the Boeing 707, America's *first* jet transport.

Meantime, Boeing design engineers are developing years-ahead projects, many in top secret categories. The future is truly limitless. That's the beauty of working with a dynamic organization, and in an industry like aviation, which is young, with its future still ahead. It's *one* field in which you can still get in on the ground floor.

Boeing has openings now for mathematicians, physicists, scientists and engineers of ALL categories, including civil, mechanical, electrical, aeronautical, and related fields. Boeing offers you high starting salaries, a retirement plan and a host of other benefits—plus a selection of young, wide-awake communities in which to live.

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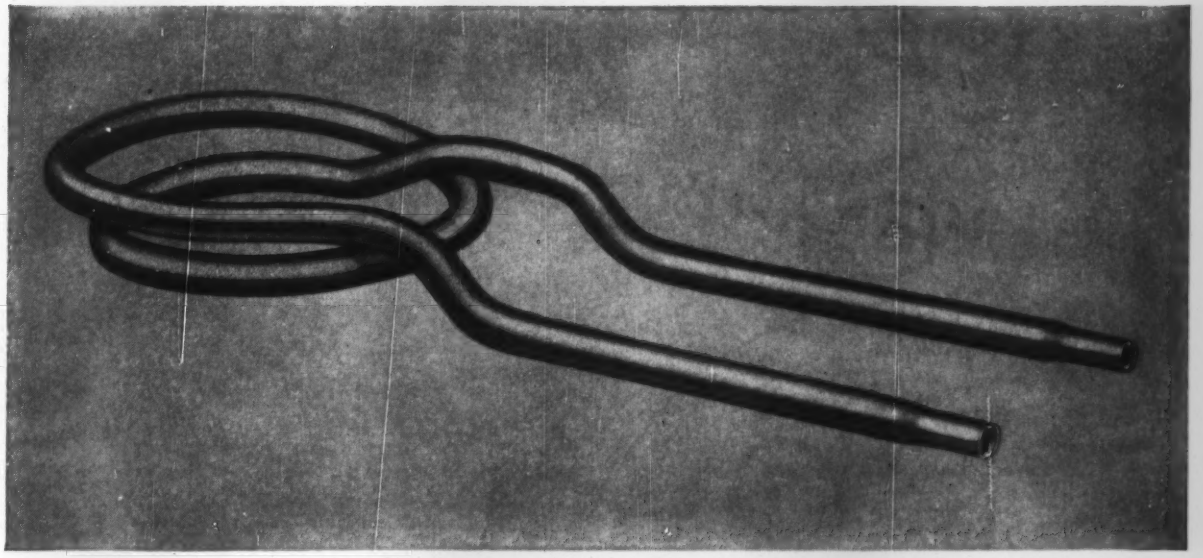

Complex shape of this oil-cooler tube lets it clear moving parts inside a compressor. Swaged ends are ready for brazing.

Bundy helps design a steel pretzel; bends it for Kelvinator compressor

Designing a compressor oil-cooler tube is tricky. It must bend like a pretzel to clear moving parts; stand up to punishing vibration indefinitely . . . yet be mass-produced quickly and economically. So when the problem arose, Kelvinator Division of American Motors Corp. consulted with the tubing experts—Bundy® design engineers.

Working together, Kelvinator and Bundy designers carefully plotted the intricate bends needed for clearance within the compressor. Next, their design took form in Bundyweld® Tubing. Bundyweld is ductile enough for easy fabrication . . . strong enough to withstand vibration fatigue . . . yet costs less than the material used in previous designs. Finally, the job was turned over to Bundy's modern tubing-fabrication facilities for mass production.

This is but one of the countless problems solved by teamwork between Bundy and our customers in many industries. In addition to years of experience, we have the advantage of working with Bundyweld—the only small-diameter tubing made by the exclusive process shown below. *Leak-proof by test*, Bundyweld is the safety standard of the refrigeration and automotive industries . . . *is used on 95% of today's cars, in an average of 20 applications each.*

If you have tubing design or fabrication problems, Bundy has the answers. It will pay you to call, write, or wire us today!

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WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

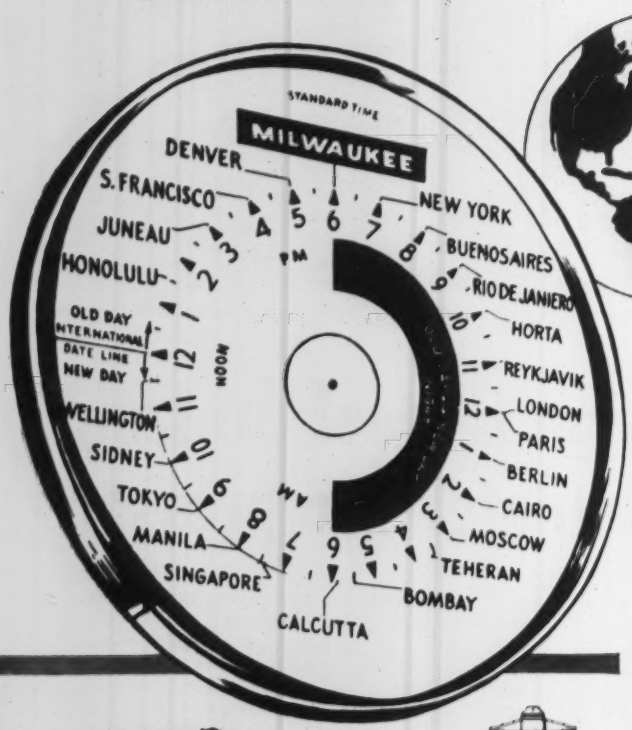
Bundyweld starts as a single strip of copper-coated steel. Then it's
. . . continuously rolled twice around laterally into a tube of uniform thickness and passed
through a furnace. Copper coating fuses with steel. Result . . .
SIZES UP TO ¾" O.D.
Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

BUNDYWELD® TUBING

DOUBLE-WALLED FROM A SINGLE STRIP

DAY and NIGHT AROUND THE WORLD . . .



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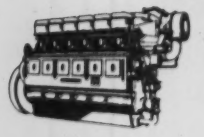
An Invitation . . . Each year Nordberg welcomes into its organization young men with ambition and education. If you are interested in an engineering career at Nordberg, write to the Employment Manager for a copy of the booklet "Your Engineering Future with Nordberg."



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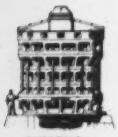

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SYMONS CONE CRUSHERS

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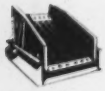

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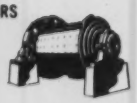

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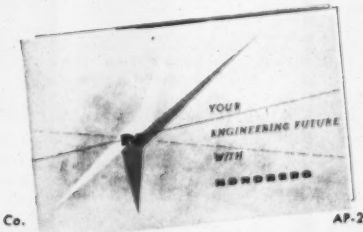

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Milwaukee, Wisconsin

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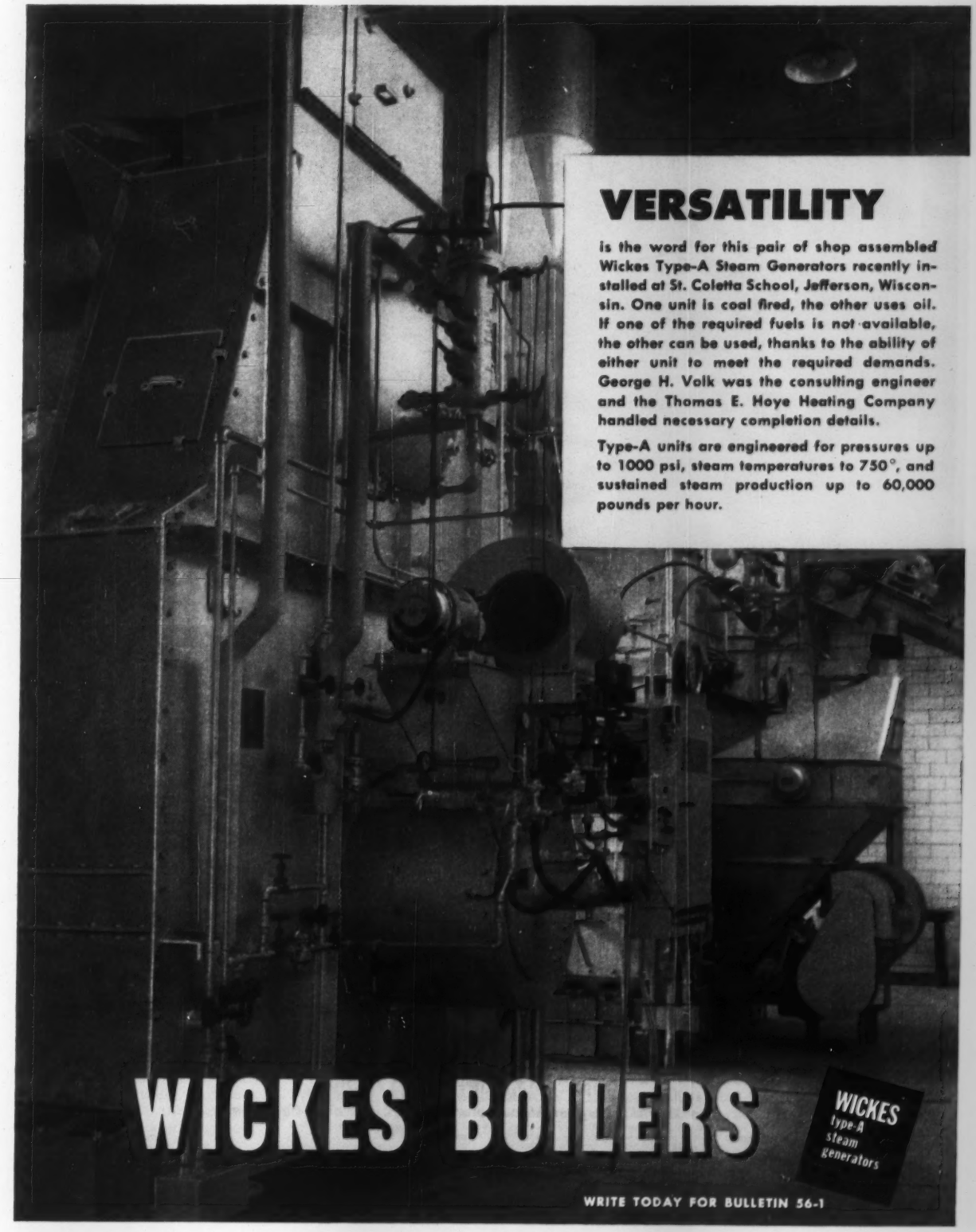
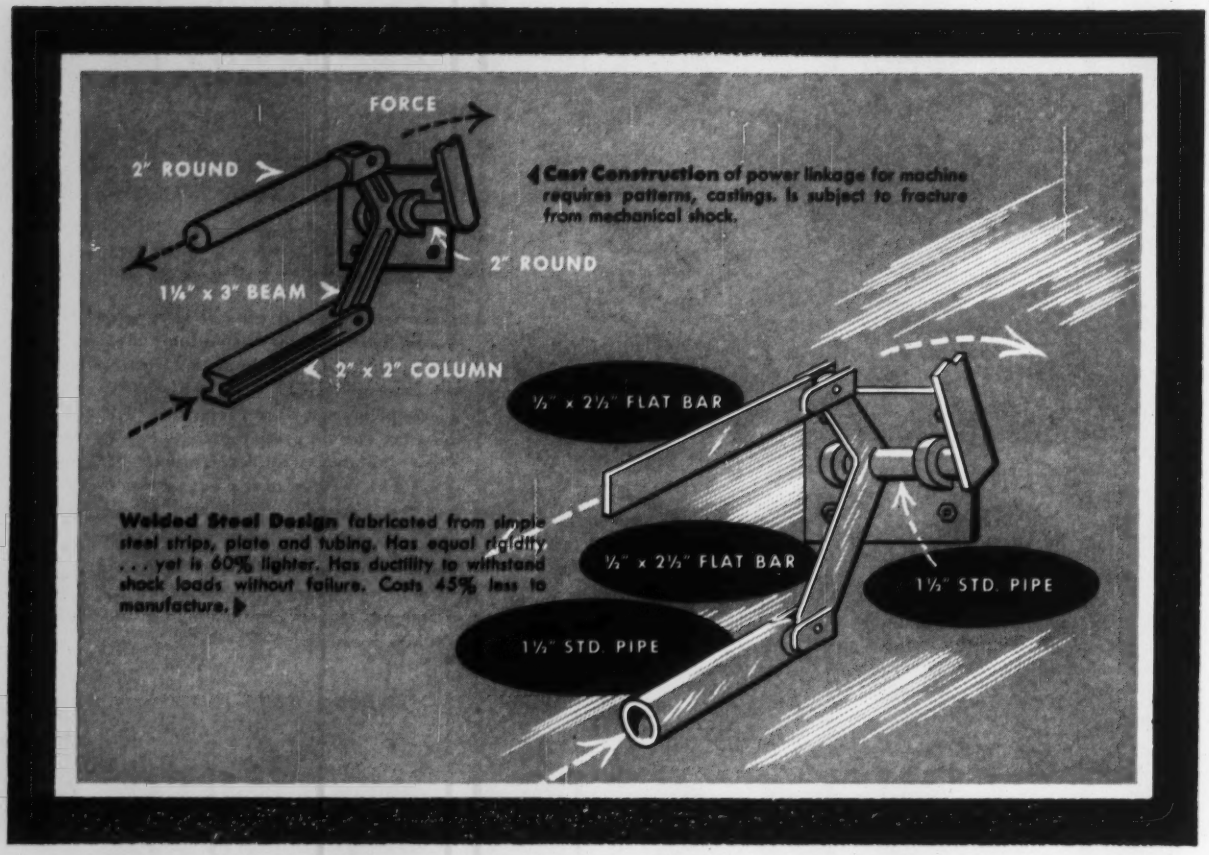

VERSATILITY
is the word for this pair of shop assembled Wickes Type-A Steam Generators recently installed at St. Coletta School, Jefferson, Wisconsin. One unit is coal fired, the other uses oil. If one of the required fuels is not available, the other can be used, thanks to the ability of either unit to meet the required demands. George H. Volk was the consulting engineer and the Thomas E. Hoye Heating Company handled necessary completion details.
Type-A units are engineered for pressures up to 1000 psi, steam temperatures to 750°, and sustained steam production up to 60,000 pounds per hour.
WICKES BOILERS
WICKES Type-A steam generators
WRITE TODAY FOR BULLETIN 56-1

THE WICKES BOILER CO., DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C. 165


FORCE
2" ROUND
1¼" x 3" BEAM
2" x 2" COLUMN
2" ROUND
Cast Construction of power linkage for machine requires patterns, castings. Is subject to fracture from mechanical shock.
½" x 2½" FLAT BAR
½" x 2½" FLAT BAR
1½" STD. PIPE
1½" STD. PIPE
Welded Steel Design fabricated from simple steel strips, plate and tubing. Has equal rigidity, . . . yet is 60% lighter. Has ductility to withstand shock loads without failure. Costs 45% less to manufacture.

HOW TO DESIGN FOR STEEL

and cut costs 45% . . . use 60% less material

MACHINE DESIGNERS

Write for Weldesign Sheets giving latest ideas in saving material and cost with welded steel.

THE machine linkage shown illustrates how costs can be cut on many types of product designs. Production savings come from lower material costs and from faster, simpler fabrication. The product is also stronger, more dependable in service since weight and inertia forces are lower. Modifications in design to suit customers' special needs are simpler too, because patterns and castings are no longer required.

THE LINCOLN ELECTRIC COMPANY

Dept. 4815, Cleveland 17, Ohio

The World's Largest Manufacturer of Arc Welding Equipment

When steel is 3 times stronger than iron

Has two and one-half times the rigidity

Yet costs a third as much per pound

WHY aren't your products designed for welded steel

Control section of Kellogg's electronic computer.

Electronic Route to Lower Steam Power Piping Costs

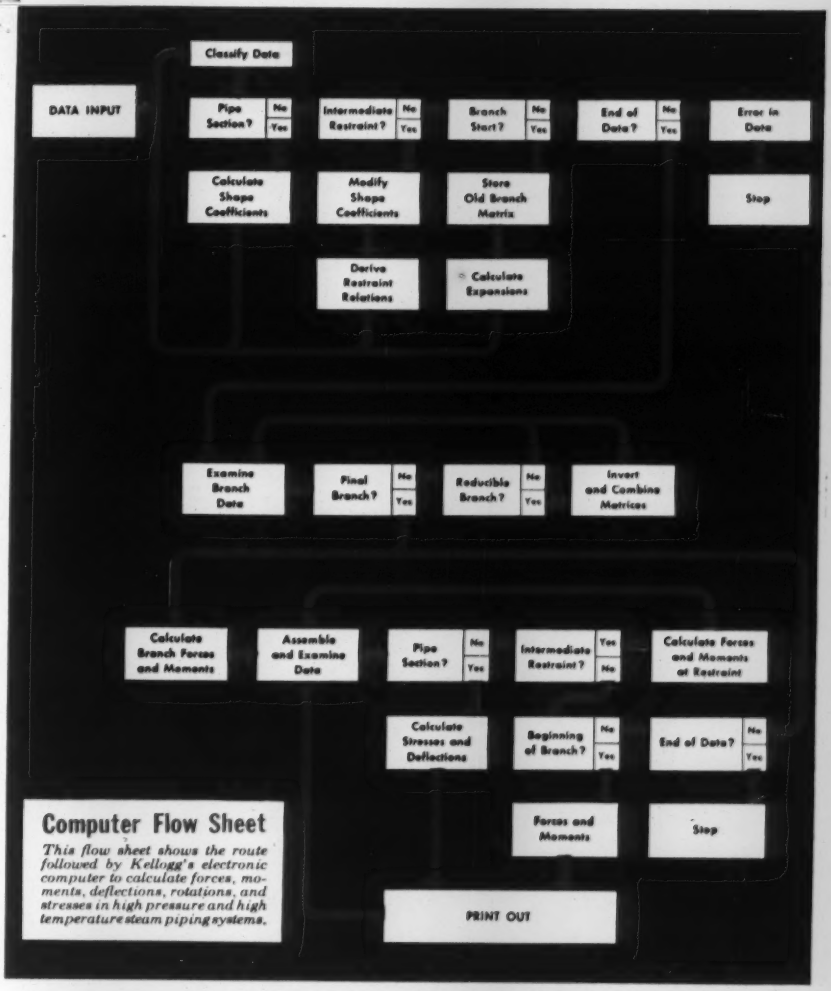
Kellogg's Digital Computer Permits More and Faster Accurate Flexibility Analysis of Complex Main and Reheat Piping Systems

KEEPING PACE with the increasingly critical pressures and temperatures of the modern steam-electric power plant are M. W. Kellogg's advanced techniques for pre-determining stresses and reactions of main and reheat piping. Most recent addition is a large magnetic drum digital computer, used to calculate forces, moments, deflections, rotations, and stresses in complex piping systems.

By enabling Kellogg engineers to undertake a far greater number of calculations in less time than ever before, electronic computation makes possible the ultimate or near ultimate piping system designs. Pipe runs can often be shortened without sacrificing required margins of safety; capital investment and maintenance costs reduced; operating efficiency increased.

A pioneer in flexibility analysis techniques, which include manual calculations, model testing, and a smaller electronic computer, Kellogg continues its pioneering in the power piping industry by the addition of this high speed computer to its New York engineering facilities.

A cordial invitation to see the M. W. Kellogg electronic computer at work is extended to consulting engineers and to engineers of power generating companies and their equipment manufacturers. Appointments may be made through the Sales Manager, Fabricated Products Division.



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PROFESSIONAL AMATEUR—*The Biography of Charles Franklin Kettering* **$4.50**

INVENTOR, engineer, humanitarian, philanthropist, philosopher, "Boss Ket" has lived the American dream. It was his vision, faith and inventive genius which gave us the self-starter, the electric cash register, "Ethyl" gasoline, the new-type diesel engine, high octane fuel, and which today, through the Sloan-Kettering Institute, is tirelessly searching for a cancer cure.

How this modern-day Ben Franklin rose from farm boy to head of General Motors' Research and achieved fame and fortune in the great American tradition is an inspiring story, filled with all the color, drama and excitement of this country's wonderful pageant of progress in the twentieth century.

I REMEMBER — *Autobiography of Dexter S. Kimball* **$4.00**

This is the vital story of a dynamic era and the equally engrossing story of an intrepid leader in industry, engineering, and education. What Dean Kimball remembers ranges from the San Francisco in the eighties to the college campus of today, and from engineering education to engineering practice. Also reflected is his outstanding work with the War Production Board in Washington, and his guiding role in the expansion of Cornell and its establishment as a great engineering school.

ADVENTURES *in the Navy, in Education, Science, Engineering, and in War.* By W. F. Durand **$4.00**

Here Dr. Durand records what he considers to be the most interesting and important events of his life. They include his researches at Cornell on the performance of ship propellers, the aeronautical engineering problems which engaged his attention at the NACA where he served as its first chairman and in other capacities for nearly thirty years, and his activities after his retirement from Stanford University as consultant on the Hoover Dam and other similar projects, and as a leading participant in the encyclopedic summary of Aerodynamic Theory.

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This is a well-documented perspective study of two people who made such a wonderful partnership of life and engineering: Frank Gilbreth whose system of motion study was a fundamental contribution to the science of industrial engineering, and Lillian Gilbreth who served as a full partner in his work during his lifetime and after his death carries on alone the work he had started.

AUTOBIOGRAPHY OF JOHN FRITZ **$3.25**

Though primarily the story of a long life of great activity, this is also the story of the development of the Bessemer process, the electric furnace, and other significant achievements which John Fritz witnessed and in which he participated.

SCIENTIFIC BLACKSMITH: *The Autobiography of Mortimer E. Cooley* **$3.75**

Dean Cooley's memoirs, written when he was past eighty, provide interesting accounts of his many activities, of his years at the University of Michigan, and of the growth of its College of Engineering. The author's skill as raconteur is manifest throughout the book, making its reading pleasant and informative.

AUTOBIOGRAPHY OF WILLIAM LEROY EMMET **$3.50**

When you read this human interest story, you also read about the many developments with which the author was identified. These include the invention, design, and development of the mercury vapor-power system; the many types of apparatus and methods of distribution used extensively in the central station electric industry; the steam turbine electric apparatus, and the electrical propulsion of ships

Published by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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How three manufacturers use Anaconda superfine-grain alloys

DURAFLEX® makes swivel lamps swivel better

Berger Machine Products of Maspeth, New York, manufacturers of lighting-fixture parts, had a problem with a swivel fixture. To allow adjustment of the reflector, the two steel parts (illustrated) have to rotate 350 degrees. Steel-on-steel froze and locked. A brass ring bushing helped, but being soft allowed the steel to cut in and bind. Berger tried Duraflex, Anaconda's superfine-grain phosphor bronze, and found the answer. Its springiness, hardness and wear-resistance made a snug fit which turned easily and would hold in any position.

FORMBRITE® helps finish phone locks faster

Tele-Lock, an ingenious device for locking a dial phone, is encased in a chromium-plated brass cup. Slaymaker Lock Co., Lancaster, Pa., was using ordinary drawing brass for this cup and found finishing costs high. They turned to Formbrite, Anaconda's superfine-grain forming brass. The cups were easy to form; the slight extra spring and hardness made the fit perfect. The smooth surface of Formbrite eliminated one polishing operation and provided an ideal surface for a lasting chromium plate.

DURAFLEX makes superior contacts for Touch-Plate®

Touch-Plate Mfg. Corp., Long Beach, Calif., makes low-voltage switch systems for control of lighting in the home. It takes only a flick of the finger or elbow on the momentary contact switches to actuate a relay, or set of relays, which turns lights on or off in one room or through the house. For the contact strips in Touch-Plate wall switches they now use Duraflex, Anaconda's superfine-grain phosphor bronze, because they found it has more spring, better recovery properties. Duraflex is now used also for contacts in the relays which operate the Touch-Plate system.

FOR INFORMATION WRITE: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

G7q7

DURAFLEX® — The new superfine-grain phosphor bronze with greater endurance limit.

FORMBRITE® — The new superfine-grain drawing brass that cuts finishing costs.

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The Corporal—A Complete Missile System

The Jet Propulsion Laboratory is a stable research and development center located north of Pasadena in the foothills of the San Gabriel mountains. Covering an 80 acre area and employing 1600 people, it is close to attractive residential areas.

The Laboratory is staffed by the California Institute of Technology and develops its many projects in basic research under contract with the U.S. Government.

Opportunities open to qualified engineers of U.S. citizenship. Inquiries now invited.

In the development of guided missile systems, JPL maintains a broad responsibility. From earliest ideas to production engineering —from research and development in structures, aerodynamics, propulsion and electronic guidance, through field problems and actual troop use—full technical responsibility rests with JPL engineers and scientists.

Not only is the "Lab" responsible for the missile itself, but also for any associated ground equipment needed to insure a complete tactical weapon system.

One product of this type of systems responsibility is the Corporal—a highly accurate surface-to-surface ballistic missile. This missile, developed at the laboratory and now in production elsewhere, can be found "on active service" wherever needed in the American defense pattern.

A prime attraction at Jet Propulsion Laboratory for scientists and engineers of unusual ability is the exceptional opportunity for original research afforded by close integration with such vital programs.

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A DIVISION OF CALIFORNIA INSTITUTE OF TECHNOLOGY

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"You can form dies 4 times faster with Formica S-52 die stock"

S-52 aircraft die used by Twin Coach Corp. for forming this beaded skin airplane wing part. It is machined to a tolerance of .005" and can easily be lifted by one man.

"We cut our die forming time from 4 months to 4 weeks when we switched from steel to Formica S-52 die stock," declares Stephen Chojnacki, general foreman, Aircraft Division plant, Twin Coach Corp., Buffalo.

"Twin Coach has been using Formica S-52 laminated plastics for over four years now, for pressing aircraft and coach parts. It's the most economical material we've ever used for this purpose.

"S-52 is easier to machine to close tolerances. It has a hard, dense structure that holds its shape. And its smooth surface never puts a pattern in the metal being formed."

Manufacturers interested in better, faster and cheaper forming of non-ferrous metal, plastic, wood, rubber, vulcanized fibre and other ductile materials — should check Formica S-52. Send today for your free copy of bulletin 604. Formica Corporation, subsidiary of American Cyanamid, 4547-7 Spring Grove Ave., Cincinnati 32, Ohio.

S-52 8 ways better than steel dies:

1. Faster, cheaper and easier to machine.
2. Easier to handle and move — it's light in weight.
3. Longer die life — some dies in use at Twin Coach for 4 years, withstand pressure up to 10,000 psi.
4. Rejects reduced from 50% with steel dies, to nothing with S-52 which prevents metal in dies from flaking off.
5. Takes deeper tooling — although easily machined, S-52 retains rigidity.
6. Prevents sticking, retains lubricant.
7. Eliminates tool drawings — die makers work directly from templates.
8. Offers more surface per pound per dollar

Save your engineers . . . . **use Formica 4 the complete laminated plastics service**

FORMICA

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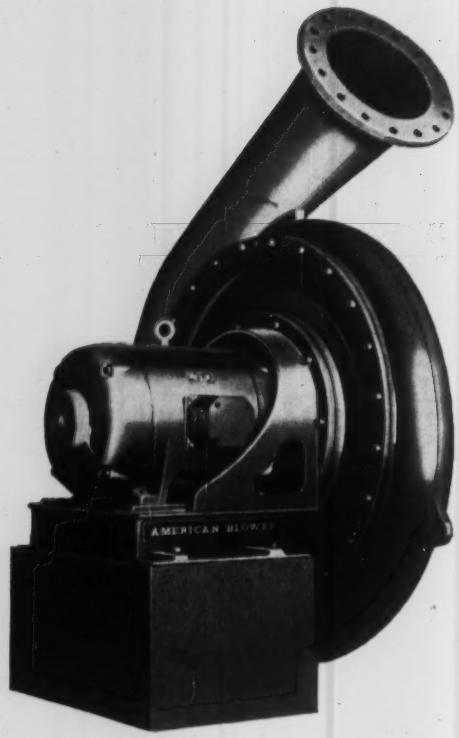
FI-1422



An American Blower 250-hp single-stage centrifugal compressor like this one has been in operation as a cupola blower in a foundry for more than 25,000 hours. *Not once has it been down for repairs.*

Dependable performance like this is typical of American Blower Centrifugal Compressors. They're available in single-stage sizes—35 to 2500 hp; pressures from 3/4 to 7 1/2 lb. (psig); volumes from 2500 to 140,000 cfm.

If *you* have a problem involving the application of centrifugal compressors, why not get in touch with our nearest branch for detailed product information?

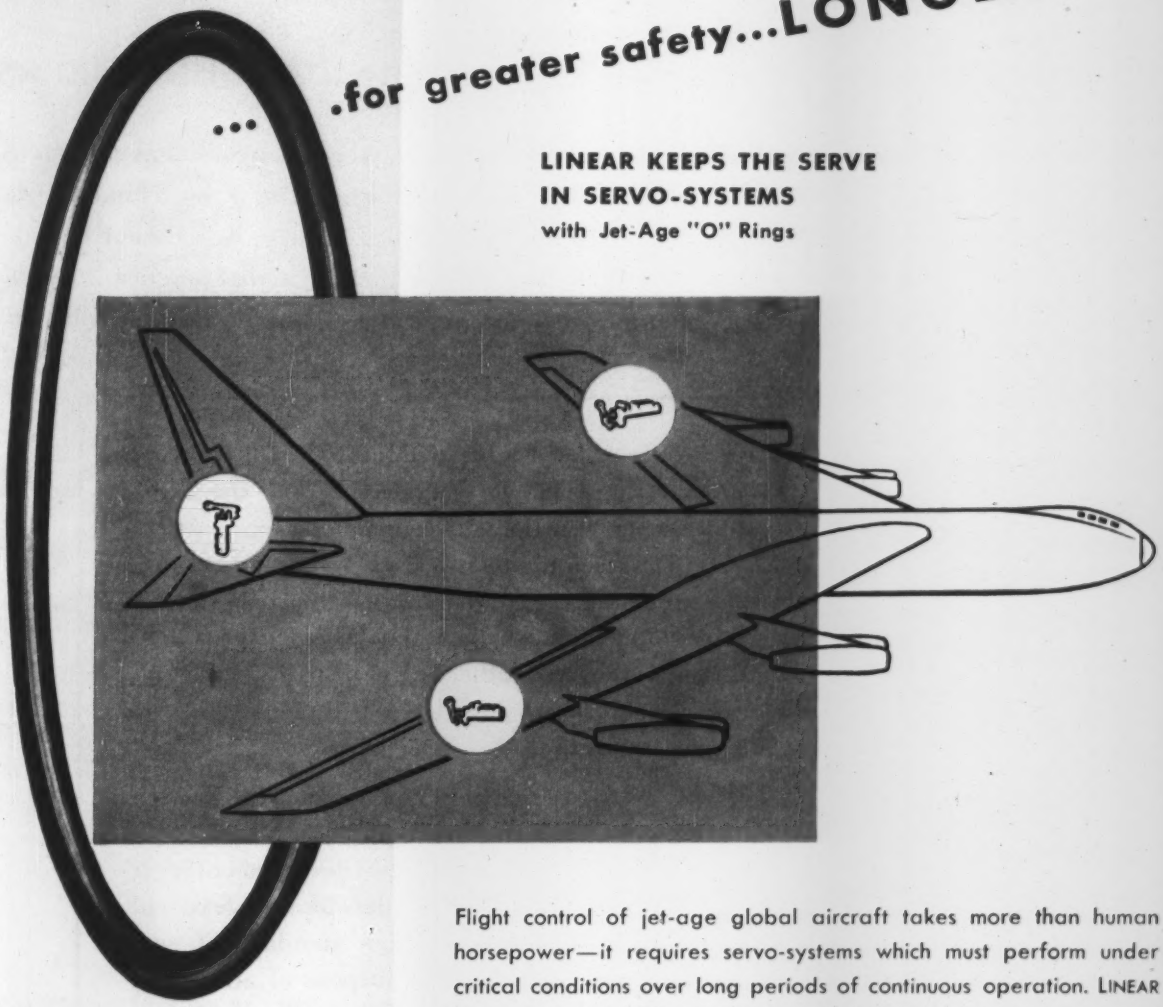
American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ont.

AMERICAN BLOWER

Division of AMERICAN-Standard

...for greater safety...LONGER

LINEAR KEEPS THE SERVE IN SERVO-SYSTEMS
with Jet-Age "O" Rings



Flight control of jet-age global aircraft takes more than human horsepower—it requires servo-systems which must perform under critical conditions over long periods of continuous operation. LINEAR has developed "O" rings and seals that keep the serve in servo-systems—to keep these planes in the air longer—safely.

For these critical requirements, LINEAR developed precision "O" rings molded of the newest elastomers to meet the most rigid specifications. They will withstand temperatures of from −130° to 550°F —give long service life under severe mechanical abuse—and will withstand the destructive action of such fluids as silicate and phosphate esters, hydrocarbons and synthetic lubricants.

When it's a sealing problem, call on LINEAR or one of its agents for engineering assistance . . .
and be sure to specify LINEAR "O" Rings.

"PERFECTION IN RUBBER"
LINEAR
LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

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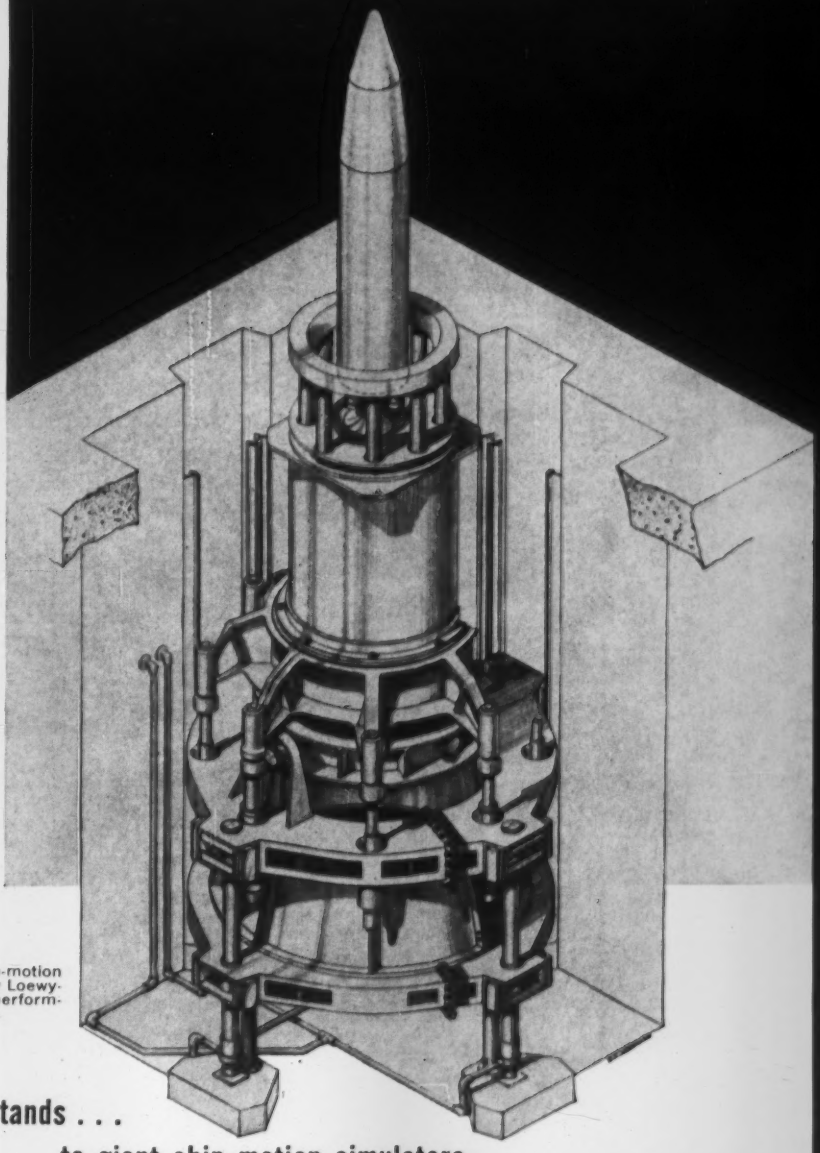
ME 6-57

Static testing and launching stand for Vanguard Earth Satellite and Rocket designed and built by Loewy-Hydropress. Prime contractor—The Martin Company, Baltimore.



Engineer's isometric drawing of ship-motion simulator, designed and being built by Loewy-Hydropress, which will evaluate the performance of the Navy Fleet Ballistic Missile.

From static testing and launching stands . . .

to giant ship-motion simulators . . .

Loewy-Hydropress creative engineering finds the solution

Loewy-Hydropress, which designed, built and installed the static testing and launching platform for the earth's first man-made satellite, has designed and is now building an enormous simulator to duplicate ship motions for the Navy Fleet Ballistic Missile Program. Involving several significant advances in the concept of automatic control of large forces, this simulator will be used for the purpose of checking guidance and fire-control systems, as well as handling, checkout, and actual firing procedures for ship-launched missiles.

The major function of the simulator will be to determine the limiting conditions under which a missile can be safely launched from a moving platform without interference from that platform. In so doing, this elaborate device will duplicate a periodic roll and pitch in any direction while simultaneously producing a heave motion. The simulator's supporting auxiliaries and environment—also by Loewy-Hydropress—will help create an integrated, functional and versatile research tool for the Navy.

The same talents responsible for the earth satellite launching platform and the ship motion simulator are available to help you solve your missile ground-support problems. Whether test facilities, or launching stands, or a combination of both, Loewy-Hydropress will supply a complete ground handling system.

If your missile contracts require creative engineering and design, research and development, direct your inquiries to us, Dept. F-6.

Loewy-Hydropress Division

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frame of reference

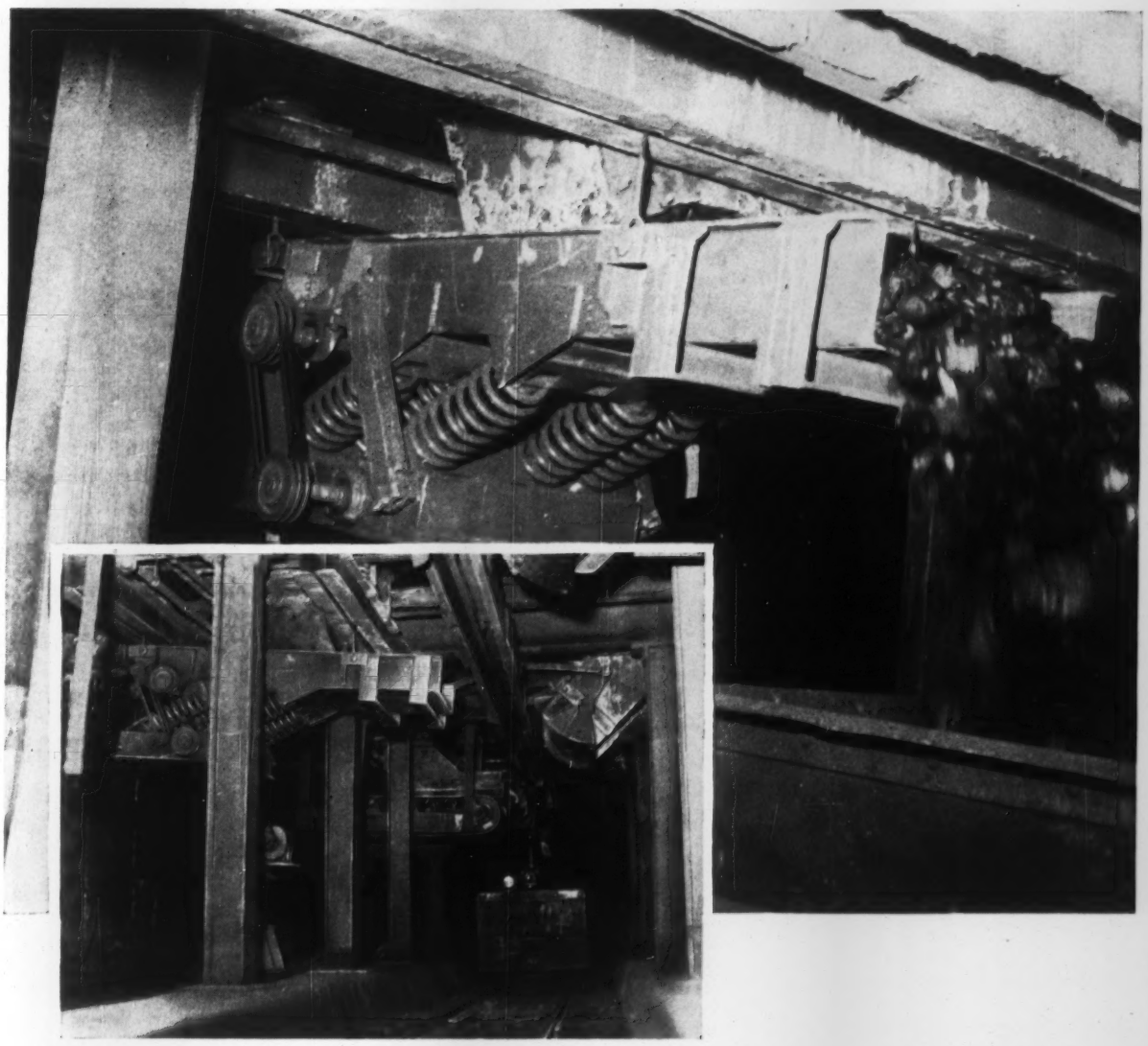
The chart below is a simplified representation of 11 different staff member fields at Sandia Corporation. You might call it an occupational frame of reference, within which are located the many activities involved in our work—design and development of nuclear weapons for the Atomic Energy Commission. In each of the 11 fields, challenging positions are available for qualified engineers and scientists at all degree and experience levels.

	ENGINEERING	PHYSICS	MATHEMATICS
Applied Research			
Weapon Systems Engineering			
Component Development			
Electronic Development			
Handling Equipment Design			
Standards Engineering			
Quality Assurance and Surveillance			
Environmental Testing			
Field Testing			
Manufacturing Relations Engineering			
Military Liaison and Field Engineering			

There are many other things you'll want to know about Sandia Corporation. You'll be interested in our extremely liberal employee benefits. You'll want to know about the advantages of working and living in Albuquerque, famous for its healthful year-round climate and recreational attractions. You'll want information on schools, homes, and cultural facilities. And you'll want to know more about our work, and our background as a research and development laboratory. Our illustrated brochure answers these questions, and many others. For your copy, please write to Staff Employment Section 553A.

SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO



140 tons of ore per hour...with only 1 h.p.!

THIS Carrier Natural-Frequency Vibrating Feeder easily handles 140 to 150 tons of ore per hour with its 1 h.p. motor, because 90% of the power is supplied by rugged coil springs, utilizing Carrier's principle of "Natural Frequency." Most of the force required to compress the springs is returned when the spring expands.

Only 10% of the force required to vibrate the pan is transmitted through the bearings. This extremely low input-horsepower requirement, coupled with the elimination of large stress concentrations, guarantees low maintenance and less downtime.

Other design advantages of this Carrier unit include:

Mechanical Dependability—No complicated electrical system required. Simple mechanical drive system—unaffected by dust or magnetic particles.

Rugged Construction—Troughs fabricated of $\frac{1}{4}$" to 1"-thick steel plate, depending on width. Can be furnished with wear plates if desired.

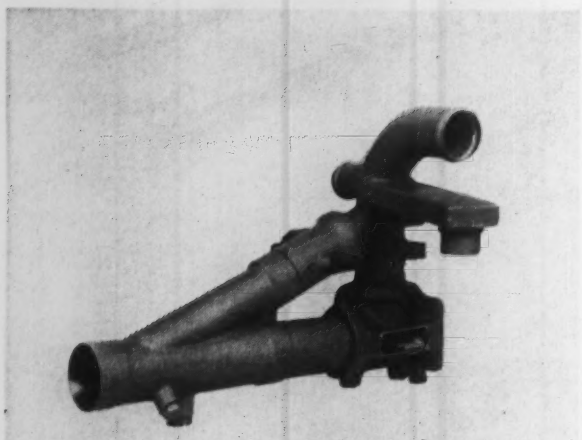
Easy Installation—Natural-Frequency Feeders can be floor-supported or suspended from above.

Greater Length—Standard feeders available in 6, 12 feet lengths, or greater if required.

Special Designs—Units may be designed with grizzly and screen decks for sizing, separating and dewatering. High-temperature units available for materials up to 2000°F.

Full details on the application of Carrier Conveyors and Feeders to your materials handling may be obtained by writing to: Carrier Conveyor Corporation, 236 No. Jackson Street, Louisville 2, Kentucky.

CARRIER
-NATURAL-FREQUENCY-
CONVEYORS



MODEL 111 BLOWER
High speed, lightweight, small size. For missile applications.

MODEL 119
ALTERNATOR COOLER
Shut-off Valve. Pneumatically-actuated, open-closed, butterfly type.

MODEL 100 BLOWER
For aircraft applications. High speed, high pressure rise.

for PUMPS... COMPRESSORS... TURBINES...

and other dependable accessories...specify

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Successful engineering demands the highest order of creative thinking, tempered by a finely-tuned sense of responsibility. At Propulsion Research Corporation you'll find such engineering to an exceptional degree, always balanced by a deep understanding and appreciation of your problems. This blending of skill, purpose and understanding enables PRC to create accessories which set new standards of performance and efficiency for both aircraft and missiles. And in addition to providing a fully-engineered accessory to your specific needs, PRC has the integrated production facilities to produce your accessory efficiently, accurately and economically. You're invited to utilize the exceptional talent and experience of PRC – you need only call in our accessories engineers. They'll be glad to work with you.

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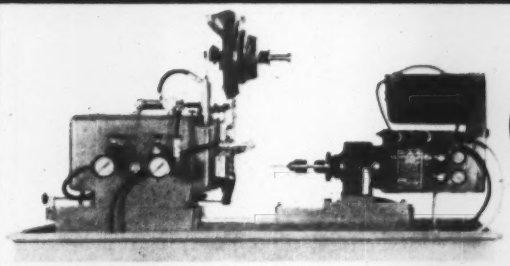
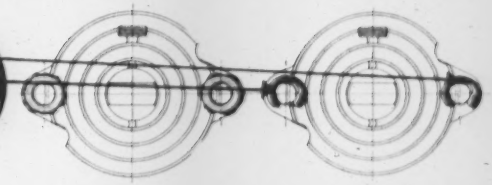
Waldes Truarc Retaining Rings Eliminate Machining and Parts—Cut Assembly Time on Drill and Tapper



Beco Model 410 Drill and Tapper

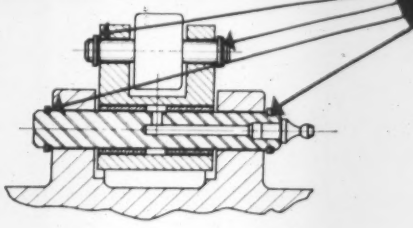
The Batchelder Engineering Co., Inc., Springfield, Vermont uses 4 different sizes of 2 different type Waldes Truarc rings in their new BECO Model 410 Automatic Drill and Tapper. Truarc rings speed assembly, reduce machining, improve design.



ALTERNATE DESIGN TRUARC DESIGN

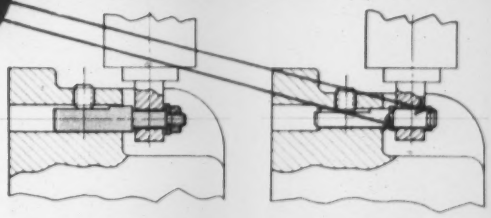
Clamp Cylinder Rod Stop Assembly

Truarc "E" Rings (Series 5133) replace stop nuts in the Clamp Cylinder assembly. They eliminate need for threading 2 rods ...the danger of cross-threading nuts...and costly rejects. Truarc Rings cut assembly time and cost.



Bell Crank Pivot Assembly

Truarc Rings (Series 5100) in Bell Crank Pivot assembly permit grease hole not possible with cotter pin fastener. Use of nuts would have increased machining and assembly costs considerably.



ALTERNATE DESIGN TRUARC DESIGN

Hopper Cylinder Anchor Pin Assembly

2 Truarc Rings (Series 5100) secure and position end of vertical air cylinder. Rings eliminate extra cost of machining 3 diameter pin, threading and undercutting...plus nut and washer. Assembly is quick and sure.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product... to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types... as many as 97 different sizes within a type... 5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today... let our Truarc engineers help you solve design, assembly and production problems... without obligation.

For precision internal grooving and undercutting... Waldes Truarc Grooving Tool!

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Please send the new supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.
(Please print)

Name .....
Title .....
Company .....
Business Address .....
City ..... *Zone* ..... *State* .....

ME069

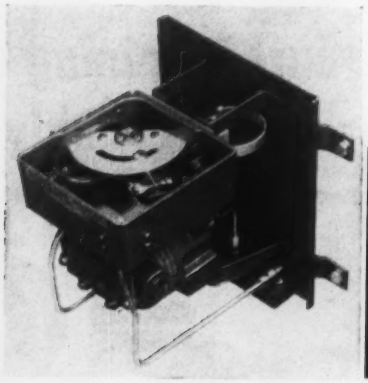
WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

REPUBLIC

announces a

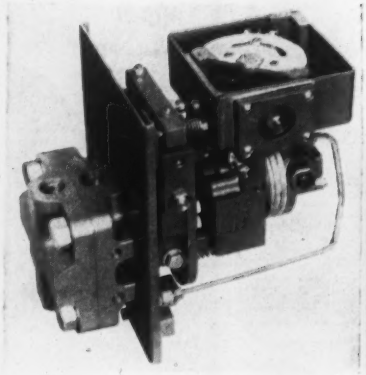
double break-through

in pneumatic transmitter rangeability!



TYPE VP

Pressure Transmitter
Standard Ranges
0-150 to 0-4000 psi
0-60" H_2O to 0-150 psi
0-1½" to 0-60" H_2O



TYPE VDP

Differential Transmitter
Standard Range
0-15 to 0-300" H_2O

- **Null-balance-*vector* design permits 20-to-1 range adjustment without re-setting zero!**
- **Suppression of range lower limit simply adjusted up to 50% of span!**
- **New compactness and weight saving solve most location problems.**
- **Low air consumption.**
- **Simplified, accessible mechanism for quick and easy servicing.**

Republic has *literally* figured all the angles to bring you this new "family" of pneumatic transmitters for pressure and differential pressure. The null-balance-*vector* units are compact, easy to install and adjust, and permit range changes far beyond any pneumatic instruments previously available to industry—and *without changing* parts. You need only a screwdriver and reference gauge to change either the upper or lower range limit!

Adjustment time is radically cut since re-zeroing of the instrument is seldom needed when the upper range limit is changed. Unusually large changes in plant operating conditions can be accommodated quickly and without new or modified equipment, simply by loosening a set screw and moving one linkage component.

Republic Type VP and VDP pneumatic transmitters normally provide standard 3-15 psi output signal pressures. Air consumption is only 0.2 scfm since air flow virtually stops as soon as the transmitter balances each input signal change. And all Republic null-balance-vector instruments have top sensitivity *and* stability. Lightweight tension members in the balancing linkage respond quickly to pressure or differential changes and do not overshoot or "hunt" the balance point.

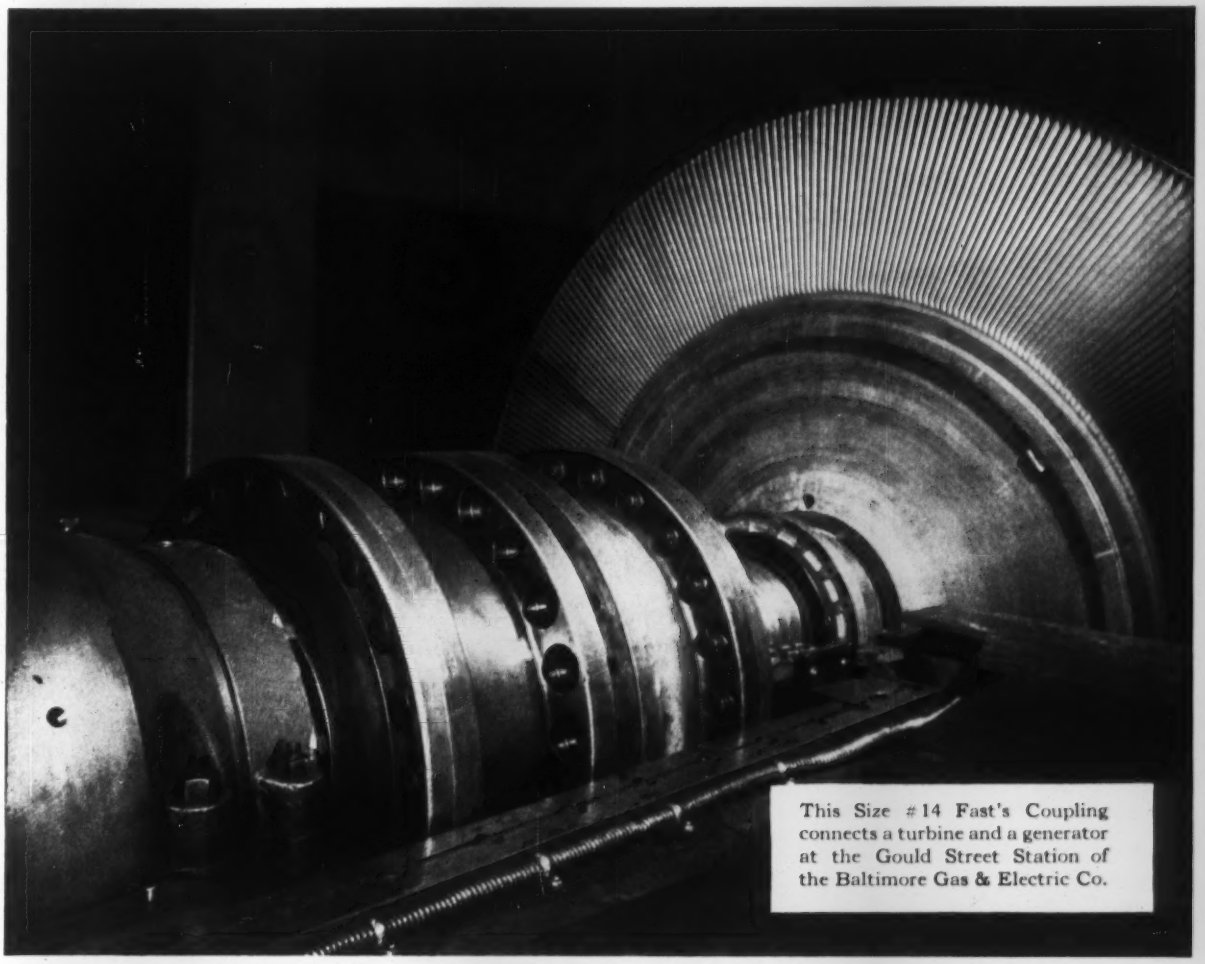
Whether your plant conditions change frequently or you just want the best sensitivity, accuracy and reliability available in pneumatic transmitters, you should get the full details on Republic Type VP and VDP transmitters.

WRITE FOR REPUBLIC FOLIOS NO. 56-12 AND 56-13A TODAY... and keep an eye on Republic for new developments "in the works" now to help you with your most critical operating instrument problems.

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company

2240 Diversey Parkway • Chicago 47, Illinois



This Size #14 Fast's Coupling connects a turbine and a generator at the Gould Street Station of the Baltimore Gas & Electric Co.

This Fast's Coupling runs smooth after 29 years of service!

This Size #14 Fast's Coupling has never had a major part replaced since its installation on January 4, 1927.

The Baltimore Gas & Electric Company has provided excellent care and inspection . . . examining the coupling during each routine overhaul of the turbine and generator. The last inspection (shown above) was during the fall of 1955.

Unique design permits Fast's Couplings to compensate for both offset and angular misalignment of shafts and eliminates the wear of metal upon metal. It provides positive lubrication which forms a film on load-carrying surfaces of the teeth. Metal bearing rings located at the mid-axis of the teeth keep out dirt, grit and moisture—keep lubricant in. Fast's metal-to-metal seal protects the lubricant against pollution.

A Koppers engineer can show you how Fast's Couplings will give you extra years of service and reduce down-time. For more details, write to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 3402 Scott Street, Baltimore 3, Maryland.

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THE ORIGINAL
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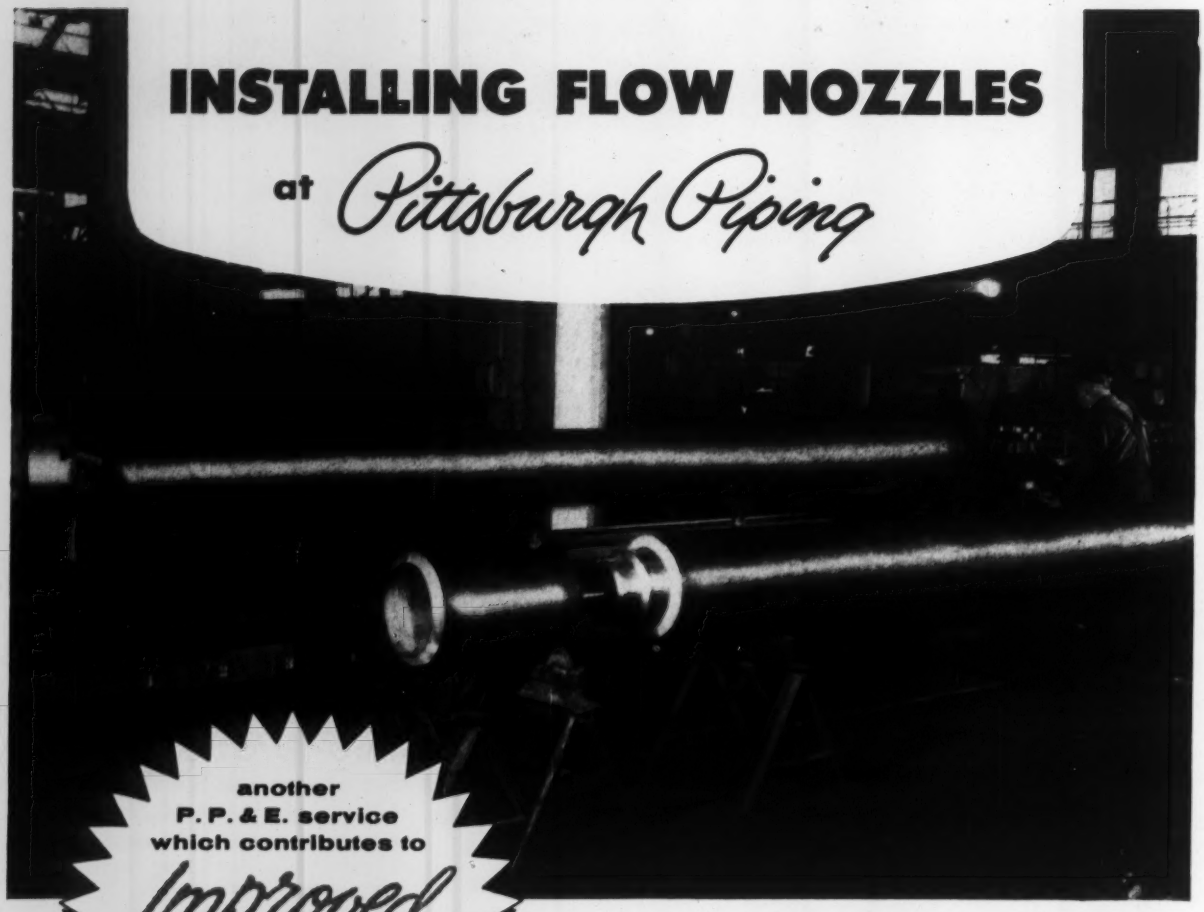
INSTALLING FLOW NOZZLES

at *Pittsburgh Piping*



another
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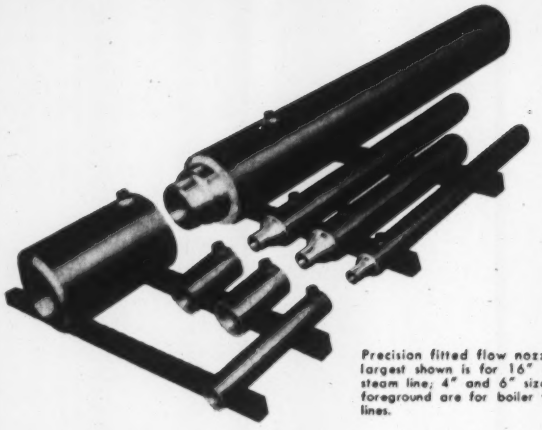
Pittsburgh Piping's precision installation of flow nozzles in high-pressure piping is the result of extremely skillful machining, fitting, and welding by experienced craftsmen. This is another example of advanced techniques — available at Pittsburgh Piping — which provide greater safety, higher efficiency and longer life from high-pressure, high-temperature piping.



Precision fitted flow nozzles; largest shown is for 16" main steam line; 4" and 6" sizes in foreground are for boiler feed lines.

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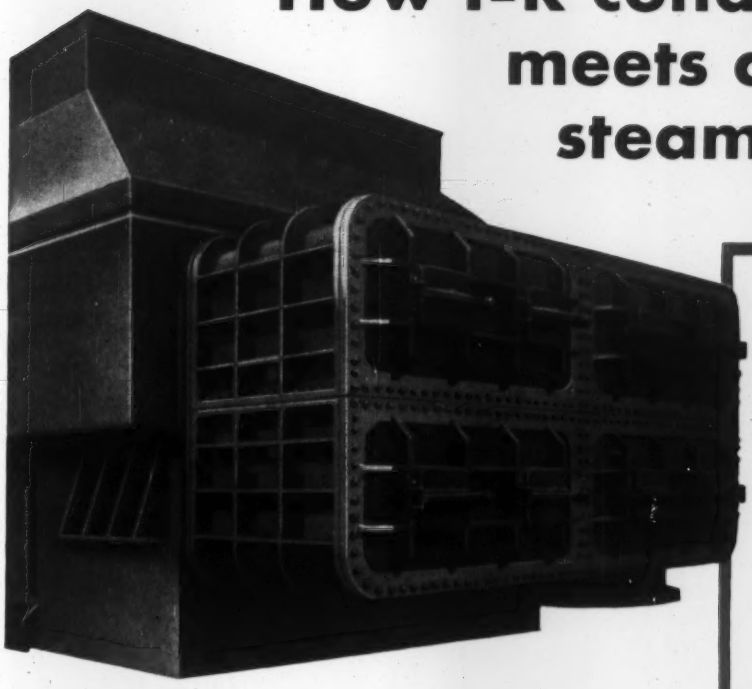
PP-19

How I-R condenser design meets all of today's steam plant needs

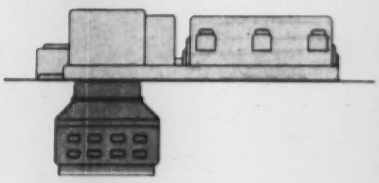


. . . Sets the pace in turbine-condenser adaptability

Permitting variations in condenser length, width and height without sacrificing performance, the Ingersoll-Rand rectangular design proves readily adaptable to all steam plant needs. Dimensional proportions can be changed over wide limits without departing from the basic standard arrangement of internal elements. This means maximum utilization of the condenser space available.

Continued refinements in I-R design are contributing to ever smaller space requirements for a given condensing capacity. These developments conform with the modern trend to higher turbine efficiencies and more compact turbine designs in reduced foundation areas for a specified kw rating.

Your I-R engineer will be glad to give you further information and submit recommendations to meet your particular requirements.

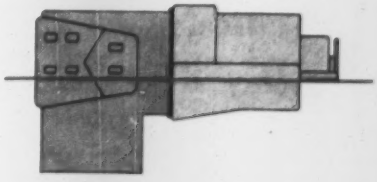


BOTTOM-EXHAUST TURBINE

Serving a 135,000-kw turbine, this condenser having 65,000 sq. ft. surface requires a headroom of only 14 feet 8 inches. It assures maximum economy of installation, operation and maintenance.

SIDE-EXHAUST TURBINE

Mounted on the turbine floor, the twin condenser shells of this I-R condenser are directly connected to the dual side exhausts of the cross-compound 191,000-kw steam-turbine.



AXIAL-EXHAUST TURBINE

Connecting directly to the exhaust of an axial flow exhaust turbine, this condenser of the single-pass rectangular type represents an outstanding example of I-R adaptability.

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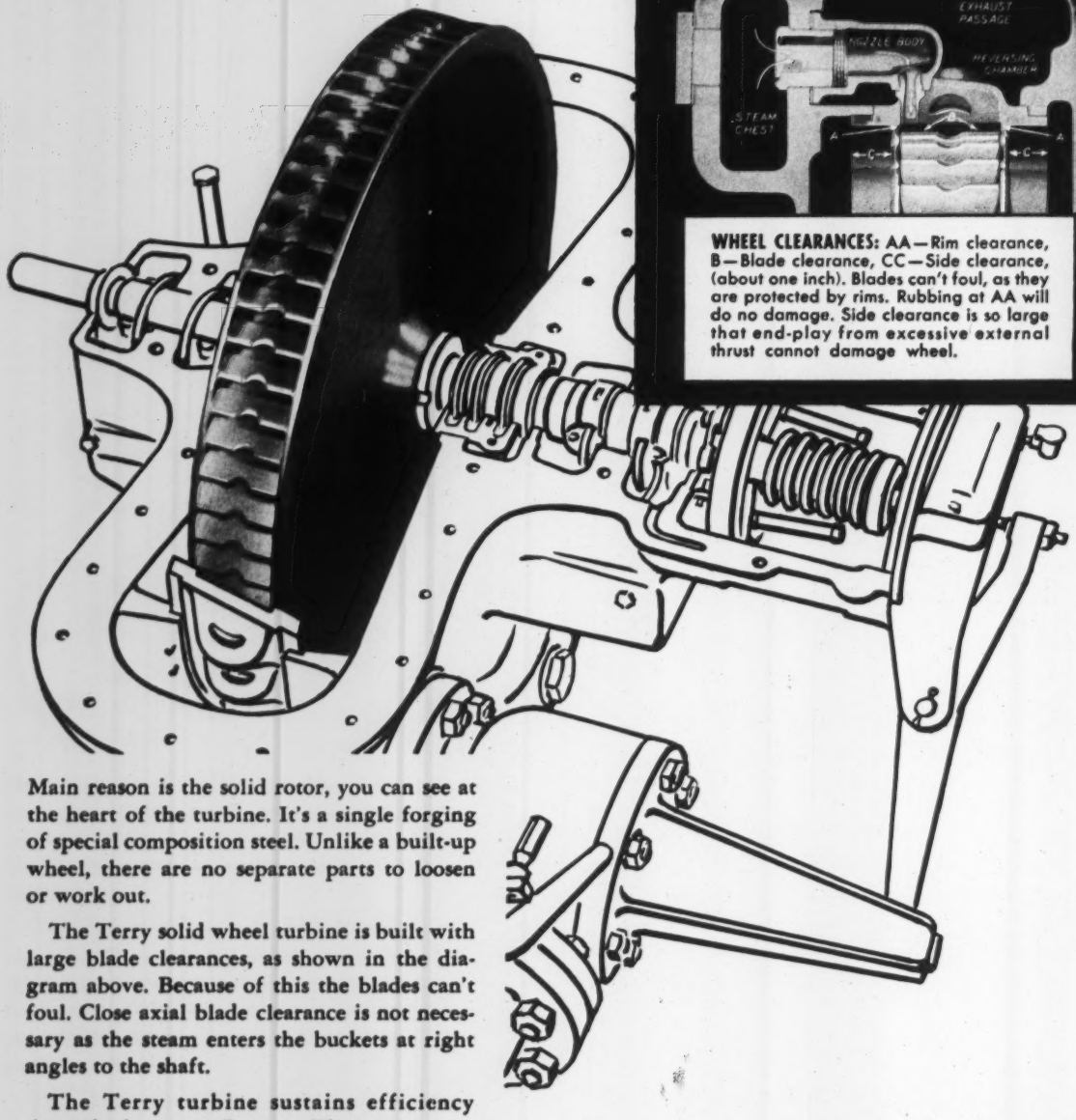
WHY TROUBLE GOES OUT

when this turbine goes in

WHEEL CLEARANCES: AA—Rim clearance, B—Blade clearance, CC—Side clearance, (about one inch). Blades can't foul, as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large that end-play from excessive external thrust cannot damage wheel.



Main reason is the solid rotor, you can see at the heart of the turbine. It's a single forging of special composition steel. Unlike a built-up wheel, there are no separate parts to loosen or work out.

The Terry solid wheel turbine is built with large blade clearances, as shown in the diagram above. Because of this the blades can't foul. Close axial blade clearance is not necessary as the steam enters the buckets at right angles to the shaft.

The Terry turbine sustains efficiency through the years. Reason: The power producing action of the steam takes place on the curved surfaces at the back of the buckets, so blade wear which might occur is of little consequence.

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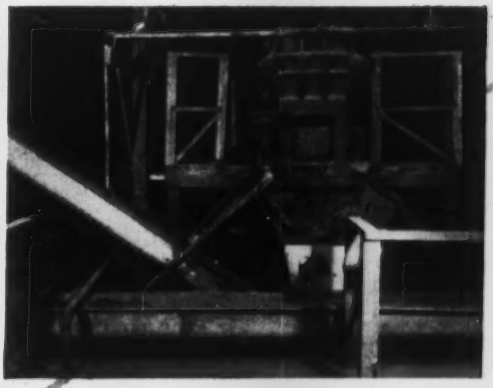

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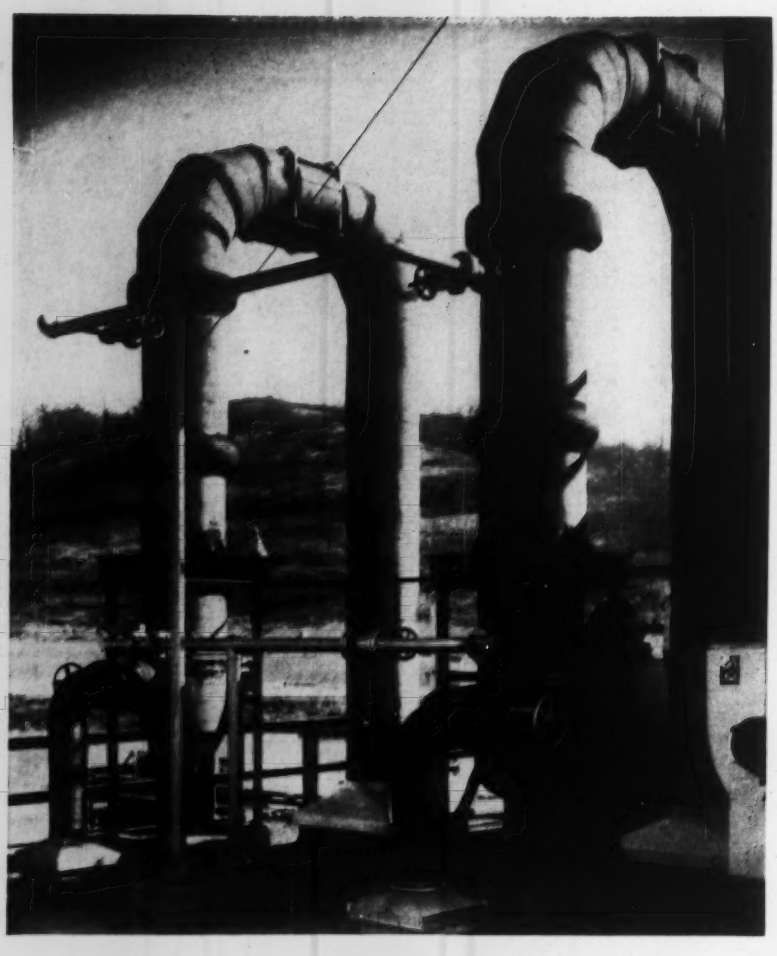

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The new Moundsville, West Virginia, plant of National Aniline Division, Allied Chemical & Dye Corp., has some of the most modern chemical processing equipment to be found anywhere in the world. Among this equipment are many Alberger Heat Exchangers, of which two are shown above as the left part of each inverted U.

The two heat exchangers are identical. Tubes, tube sheets and end sections are of nickel to handle the end product of the plant—diisocyanates. Shells with expansion joints are of carbon steel.

The final product enters the heat exchangers at the top as a gas and flows out of the exchanger as a liquid through the elbows at the left. The gas is condensed by cooling water entering and leaving the shell through the narrow silvered piping.

The axial thermal expansion of piping and heat exchangers is absorbed by nickel anti-compression expansion joints shown at the top of each inverted U. These joints were engineered and manufactured by American District Steam, which, like Alberger, is also a division of Yuba Industries, Inc.

Alberger has made 40,000 installations since its founding 53 years ago. Its engineers would be pleased to consult with you regarding heat exchangers.

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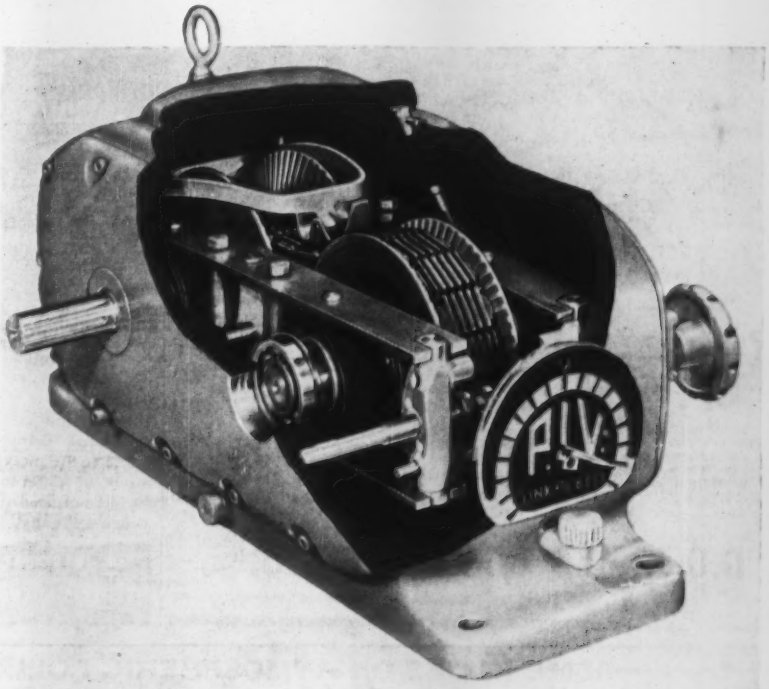

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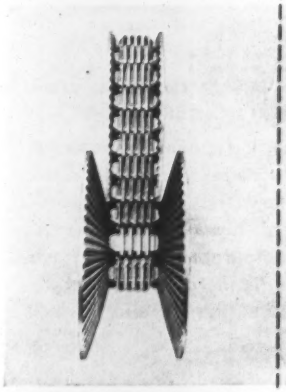
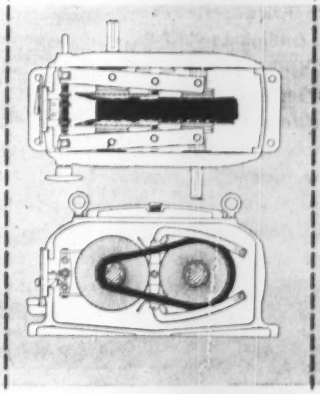
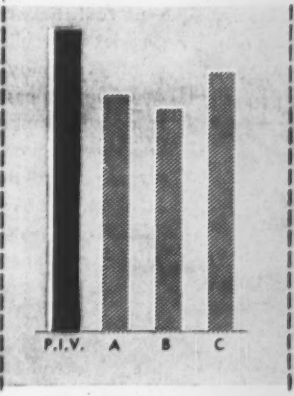
How LINK-BELT P.I.V. differs from other variable speed drives



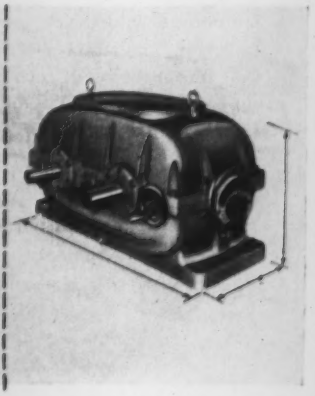
POSITIVE MESH of self tooth-forming chain with grooved wheels assures full-rated hp at output shaft. All-metal construction . . .



PREVENTS SLIPPAGE because the P.I.V. drive chain does not depend on friction and is unaffected by atmospheric conditions.



UNMATCHED ACCURACY is demonstrated by this actual comparison of maintained rpm of P.I.V. and three other variable speed drives.



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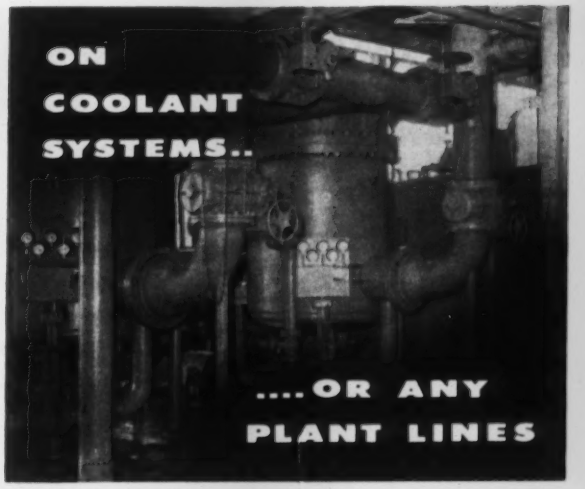

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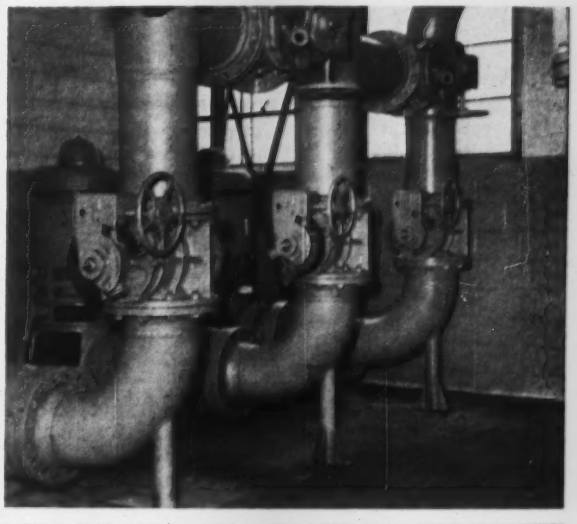

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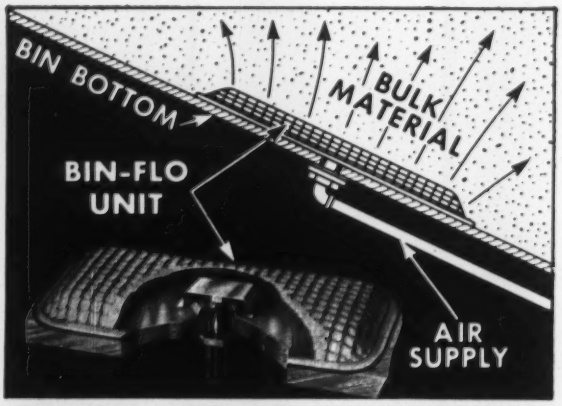

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at San Antonio, Texas

—a rapidly growing independent laboratory located in a healthful, sunny climate—
has exceptional opportunities for individuals with outstanding qualifications
in the field of Engineering Mechanics.

STRUCTURAL RESEARCH ENGINEERS
. . . . .for advanced studies in structural mechanics, experimental stress analysis, plate and shell structures, creep buckling, soil and foundation mechanics, fatigue in pressure vessels and machinery.

AERONAUTICAL ENGINEERS
. . . . .for experimental and theoretical problems in aeroelasticity, aerodynamics, dynamic and vibration analysis, instrumentation and wind tunnel testing.

MECHANICAL DESIGNERS
. . . . .for development of mechanical, electrical, hydraulic, and structural systems and components, particularly related to the gas and petro-chemical industries.

METALLURGISTS
. . . . .for research and development of new materials and layered systems to withstand ultra high temperatures, creep and stress rupture in ferrous and nonferrous materials, solid state physics.

ENGINEERING ANALYSTS
. . . . .with Engineering Mechanics, Applied Mathematics or Applied Physics backgrounds to work in any of the above fields.

If you are experienced in any of these areas and seek the challenge of working independently as a **project leader** on a diversity of industrial and military problems in both fundamental and applied fields, write to:

S. J. Keane, Manager of Technical Services
8500 Culebra Road, San Antonio 6, Texas

DESIGN ENGINEERS WHO WANT TO DO ORIGINAL THINKING

The positions now open at Air Reduction offer you just such opportunity. New plants, facilities, processes, equipment, systems, etc., are needed for our expanded chemical activities as well as to meet the growth in demand for our industrial gases. The solutions to these projects and the maintenance of Air Reduction's leadership in the future will enable you to have a rewarding, creative satisfying career while benefiting from the security that is inherent in a company so broadly diversified.

Our personnel policies offer you many advantages. A full range of benefits include a well established pension plan, group insurance and stock-investment plans, tuition plan to further your education. Salaries are open—depending on your ability and experience. . . . Relocation Assistance Will Be Given

Present openings for design engineers in design and construction of low and high temperature process units, heavy materials handling equipment, utility systems and related buildings.

SENIOR ENGINEERS

Minimum B.S. Degree in mechanical engineering. Not less than 5 years in equipment and plant design activities. Experience in related or petro-chemical industries.

ENGINEERS

B. S. degree in mechanical engineering. Not less than 3 years of design and testing of petrochemical type equipment and plants.

Apply or send resume attention Mr. J. Holst, Chief Design Engineer

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Aggressive Research and Development activities have made Edward Valves, Inc., a leader in the steel valve industry.

We have expanded our Research facilities to maintain this position.

Openings are for Engineers (mechanical, stress, flow, materials, metallurgists) interested in design and development of valves for high pressure, high temperature service and nuclear power applications. Replies are confidential.

EDWARD VALVES, Inc.
Subsidiary of the Rockwell Manufacturing Company
1200 West 145th Street, East Chicago, Indiana
Mr. E. A. Loeser, Engineering Personnel

QUALITY CONTROL

Expanding and diversified organization has permanent and interesting openings for top-level QC Engineers and Managers at several locations. Please submit complete details of education, experience, and earnings in confidence to:

WILLIAM PLANT, CENTRAL PERSONNEL
THE GENERAL TIRE & RUBBER COMPANY
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RESEARCH AND DEVELOPMENT MATERIALS HANDLING SPECIALIST

MECHANICAL ENGINEER TO CONDUCT RESEARCH AND DEVELOPMENT OF STORAGE, METERING AND HANDLING EQUIPMENT FOR GRANULAR SOLIDS.

Balanced expansion of research program in diversified national multi-plant fabricator of durable steel products has brought need for experienced graduate or advanced-degree specialist in grain-handling methods and equipment. Travel opportunity for maintaining current contact with latest knowledge and data. Employment will be in Kansas City, Missouri, a growing and progressive midwestern city.

Salary commensurate with ability, training and experience, company-paid retirement plan, stock ownership option, liberal benefits.

Send inquiries and full particulars in confidential letter to **Orval W. Groves, Employment Supervisor,** at address shown below.

BUTLER MANUFACTURING COMPANY
7400 East 13th Street
Kansas City 26, Missouri

MECHANICAL ENGINEER for design and development of materials, mechanisms and new products in mass production consumer field. Initiative required to explore new fields.

MECHANICAL ENGINEER to participate in Value Analysis Program and trouble shooting concerning the purchasing of components and manufacturing services. May participate in the selection and procurement of machinery and tools. Must be capable of analyzing designs and processes and making economic cost analyses.

TOOL ENGINEER with heavy tool designing experience on compound and progressive dyes. Must be able to evaluate vendor tooling programs to establish internal tooling program.

Salary commensurate with experience.

Please submit resumes to: Personnel Dept.
Ronson Corporation of Pennsylvania
Delaware Water Gap, Pennsylvania

ENGINEERS AND SCIENTISTS

SHOULD YOU SWITCH TO ROCKETRY?

RMI'S NEW "TAKE-AT-HOME" TECHNICAL TEST INDICATES IF YOU'RE READY NOW FOR ROCKETRY'S HIGHER REWARDS

Like many engineers and scientists, you know that higher salaries and greater opportunity prevail at Reaction Motors... because rocketry is America's fastest-growing industry, and RMI is America's first rocket engine company.

But like many other professional men you may not realize that technical skills from many of the other familiar sciences are immediately applicable to this field... that the man who began his professional career in rocketry is the exception, the man who enters rocketry from another field, the rule.

Eight successful rocketmen who came to RMI from different fields have devised technical tests that determine whether your present training in any of eight basic areas justifies your changing to rocketry. Take the test that applies to your area in the privacy of your own home... score yourself immediately with the answer sheet provided.

If you do well, your opportunities for a successful career here are excellent... because RMI is now working on the most far-reaching developments in its 16-year history. This is the time to act if you want the maximum benefits of a switch to rocketry.

Fill out and send in the coupon below for your copy of RMI's Technical Test.

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ATT: 8 Man Task Force

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6

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SIX CAREER POSITIONS OF CHALLENGE AND RESPONSIBILITY IN SPECIALIZED AREAS OF MECHANICAL ENGINEERING

The Engineering Service Division of du Pont's Engineering Department provides consulting service and technical assistance to production, maintenance, design, research, and construction groups within the company. The Division's objectives are to assist other company units in improving plant efficiency and product quality, in reducing investment and operating costs, and in increasing capacity.

Six openings are immediately available for experienced graduate engineers to provide consulting service to operating plants in the following specialized mechanical engineering fields:

APPLIED MECHANICS

Optimum qualifications will include 5 or more years' experience in machine design, machine development, or in teaching involving the study and testing of structures, machines and pressure vessels. Practical knowledge of and experience in vibration, dynamic effects, and specification of engineering materials is desirable. Successful applicant will provide consulting service to design groups, plants, and laboratories on vibration problems and on dynamic and static stress analysis of machine components and all types of chemical plant equipment.

PROCESS EQUIPMENT

Position requires 5 or more year's engineering experience in research, development, design, application, or maintenance of chemical process equipment and machines. Duties include: conducting mechanical engineering studies on chemical plant problems involving equipment design, mechanisms, machine components, and machine drives; and analyzing and solving problems in selection, operation, and maintenance of chemical process plant equipment. Qualifications should include sound practical knowledge of engineering economics, machine design, fluid mechanics, or applied mechanics.

PUMPS & FLUID MECHANICS

Desired qualifications will include extensive engineering knowledge of and familiarity with equipment used in the fluid mechanics field. Development, research, design, maintenance, or teaching experience with pumps, compressors, jets, and seals is desirable. Responsibilities of the position will involve selection of equipment, trouble-shooting, and consultation on fluid flow and mechanical design aspects of piping, pumps, jets, compressors, and seals. Duties include evaluation of available equipment and recommendations for equipment modification for special applications.

PLASTICS ENGINEER

BS engineering or chemistry; minimum 5-10 years' experience in plastics engineering for process equipment and auxiliary services. Duties include consulting services covering development, evaluation, selection, specification and fabrication of plastics for chemical process equipment and auxiliaries; investigations of failures and recommendations of remedial measures.

POWER

Position requires extensive practical power experience including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable. Duties include: making economic evaluations and involved heat balances for complicated power systems; assisting in specification of power equipment and in selection of new facilities; and determination of causes of equipment malfunctioning and development of recommendations for corrections.

REFRIGERATION ENGINEER

Minimum BS/ME or equivalent. At least 5 years' experience in design and analysis of process cooling and air conditioning refrigeration systems, particularly in testing and performance analysis of compressors, drives, controls and heat exchangers. Duties include consulting for Engineering and Plant Operations on analysis, testing and development of refrigeration systems. Engineer will maintain liaison with Company and outside personnel. Travel to plant and other locations required. Must be articulate in speech and writing and be able to perform technical and economic analyses with minimum supervision. Should have personel trails to fit him for consulting, liaison and supervision, potentially in prominent position.

SAN FRANCISCO INTERVIEWS

Tues-Wed-Thurs-Fri
June 11-12-13-14

To arrange an appointment with our technical representative, please call

Mr. K. S. Marlin, Jr. EXbrook 2-7755

Or you may send complete resume, including details of education and experience, to:

Mr. K. S. Marlin, Jr., Engineering Department

E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Delaware

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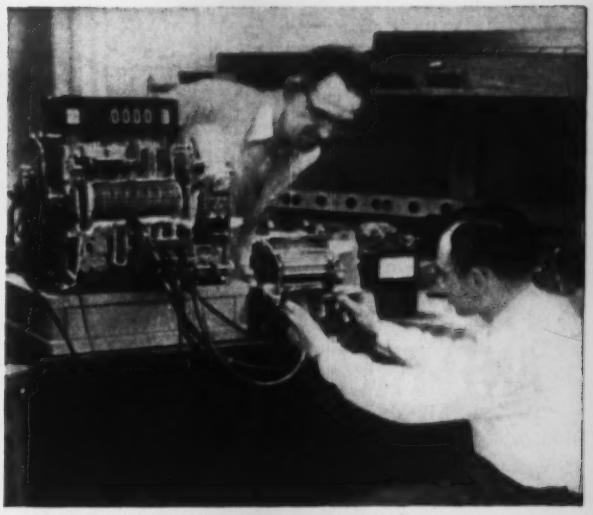
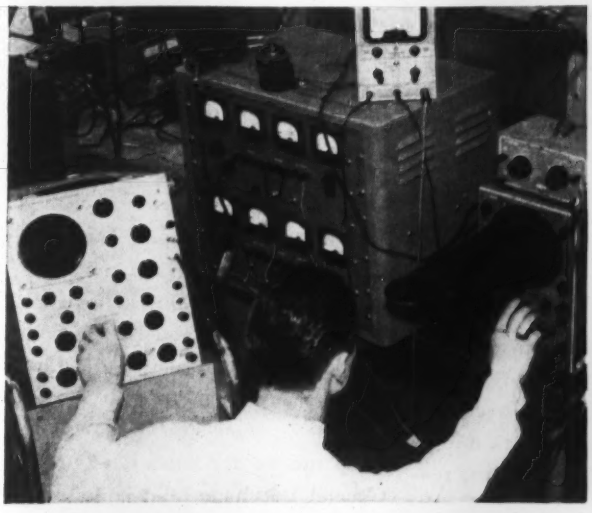
...THROUGH CHEMISTRY

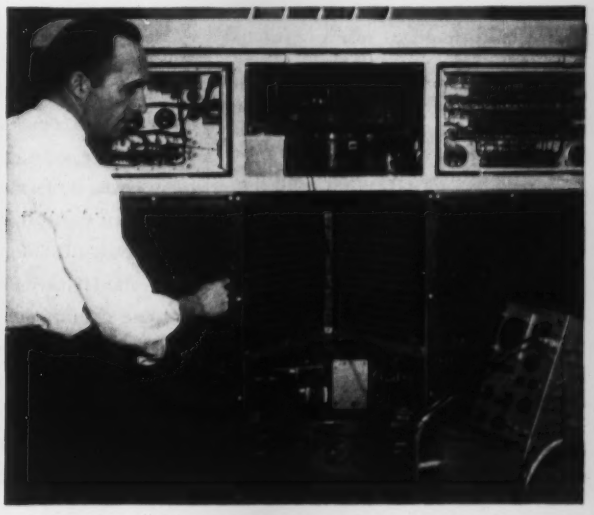
MECHANICAL ENGINEERS are using their skills in the design and development of new mechanisms required for business machines and for those mechanical products which are associated with electronic data processing equipment.



ELECTRO-MECHANICAL ENGINEERS are constantly faced with the problems of capturing information from the various input devices and converting this information into a usable form for subsequent use in data-handling equipment.



ELECTRONIC ENGINEERS enjoy an unparalleled freedom in the development of new types of circuitry and components which are necessary to maintain leadership in the competitive field of record-keeping automation.



COMPUTER ENGINEERS backed by the company's computer research since 1938 are developing an economical, flexible digital computer to meet the requirements of all record-keeping applications.

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If you are looking for a challenging opportunity with an established company which has tripled its sales in ten years—one that offers excellent starting salaries as well as permanent positions . . .

Act at once! Send resumé of your education and experience to Employment Department, Technical Procurement Sec. M, The National Cash Register Company, Dayton 9, Ohio.

NCR

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How knowledgeable are you on heat transfer in cast iron or aluminum engines? What about relating engine performance on the dynamometer to actual road test data?

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Because this is one of the major research and development centers of Union Carbide Corporation, an exceptionally wide range of technical facilities are available. Working conditions are pleasant in the modern technical center, staffed by more than 350 creative men of scientific background. The salary program is liberal, and complete employee-benefit plans are in effect.

Men with Bachelor or Master Degrees, with a high degree of individual creativeness and initiative, are required. Please send a summary of your educational background and work experience to Mr. R. P. Kalle, Dept. MEA, Linde Company, Division of Union Carbide Corporation, P.O. Box 44, Tonawanda, N. Y.

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The **GENERAL** *Idea*

ON ENGINEERING CAREERS

GENERAL SYSTEM

Electronic switching —the new challenge

Hottest conversation topic in communications circles these days is the all-electronic, transistorized switching system.

And with good reason. Electronic switching holds promise of many revolutionary advances not only in telephony but in the entire field of Communications and Controls . . . the broad area in which General Telephone Laboratories works.

For instance, transistorized switching equipment with no moving parts will increase speeds of data transmission to a degree that seems fantastic in light of present day equipment. Much equipment could be miniaturized to one-fifth its present size. Costs could be reduced right down the line. A host of pleasant innovations in telephone service would become commercially practical.

This important project is challenging the best creative talents of many physicists and electronics engineers at General Telephone Laboratories. A few of the specific projects in work are research in solid state materials, ferrite cores and other types of memory devices, designing circuits and systems, application of digital computer techniques to communications problems.

This, of course, is just one phase of the R&D work at General Telephone Laboratories. But it illustrates the point that the engineer looking for an interesting challenge to mature abilities is likely to find it here.

Working prototype of electronic switching equipment being checked by a General Tel Labs engineer.

Some fast facts about us

General Telephone Laboratories is the new expanded research and development group of Automatic Electric Company. Our job is the same as it has always been—develop better products and systems in Communications and Controls.

Our parent company, Automatic Electric, is one of the great pioneers in automatic telephony and in the whole field of automation. The dial telephone and long distance dialing are just two of the many "firsts" in their 65-year history.

To the career-minded engineer, General Telephone Laboratories offers a rare combination of advantages . . . an engineer's company . . . serving stable but fast-growing industries . . . interesting and varied work . . . broad opportunities for personal growth.

Our needs are for engineers in electronics, electrical, electro-mechanical, systems designers, mechanical engineers and physicists.

For specific information about your career opportunities, write direct to Mr. Robert Wopat, president, General Telephone Laboratories, Northlake, Ill.

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INCORPORATED

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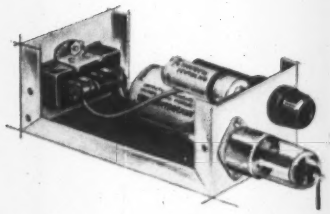
Subsidiary of Automatic Electric Company

IBM *offers Design Engineers a creative challenge in a brand-new field*



Electronic Tabulation: Typical of the electronic innovations being realized at IBM—Lexington is this revolutionary sensing unit. It permits IBM Electrics to "read" *right from the paper being typed* — automatically stopping the carriage at the desired spot.

Building "electronic intelligence" into electric typewriters means exciting new career opportunities at IBM, Lexington, Ky., in the Blue Grass Country.

IBM is now assembling a select group of designers and engineers to help apply the miracles of electronics to electric typewriters. If you are an E.E., an M.E., or a designer, there is a splendid chance to use your ingenuity and resourcefulness at IBM's new research laboratory in Lexington, Kentucky.

For the electric typewriter is destined to become far more than just a typewriter. It is changing in concept both as a single entity and as an integral part of an overall electronic business machine system. As a designer or engineer at IBM, you will find tremendous challenge, because the new electric typewriter is an advanced step in the science of communications; one worthy of the creative talents of outstanding engineers.

Many challenging career opportunities open!

In addition to the research laboratory, IBM's new manufacturing plant at Lexington offers excellent opportunities for professional and technical men:

- Electronic engineers
- Electronic technicians
- Industrial engineers
- Machine designers
- Methods engineers
- Plastics engineers and mold designers
- Product cost estimators
- Test engineers
- Tool and model makers
- Tool designers and engineers

Blue Grass Region: You'll find living conditions ideal! IBM pays moving and travel expenses.

For the facts about a career at IBM—Lexington, please write to:

Mr. R. A. Whitehorne, Dept. 506
Manager of Engineering Recruitment
International Business Machines Corporation
590 Madison Avenue, New York 22, N. Y.

IBM ELECTRIC TYPEWRITERS

DATA PROCESSING • ELECTRIC TYPEWRITERS • MILITARY PRODUCTS • SPECIAL ENGINEERING PRODUCTS • TIME EQUIPMENT

ELECTRIC BOAT ENGINEERS CAN GIVE YOU THE ANSWERS

WE CAN TELL YOU A FEW FACTS ABOUT ELECTRIC BOAT...

...that it's a rare thing for an engineer to work twice on the same sort of problem...
...that engineering turnover is virtually non-existent...
...that there have been no layoffs for over 35 years.

BUT OUR ENGINEERS ARE THE ONES WHO CAN BEST TELL YOU.

They will tell you why they like working here, and why you will do better at Electric Boat. They will tell you, perhaps, that they do *engineering* work, that they have a staff of skilled specialists and technicians to back them up.

They might tell you, too, that they like working on problems as varied as those connected with chemical process equipment, submarine systems, nuclear propulsion and wind tunnel controls.

They'll certainly mention the close working relationship with department heads which permits a free interchange of ideas and quick assistance with knotty problems.

And perhaps they'll tell you what courses they are taking while working for advanced degrees. And about their recreations—you will find plenty of enthusiastic hunters and fishermen, sailors, swimmers and skiers among them.

Please send your resume to James P. O'Brien, Technical Employment Supervisor. He will arrange an appointment for you to more fully discuss your qualifications with our engineers in Groton.

ELECTRIC BOAT DIVISION
GENERAL DYNAMICS CORPORATION
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Servo Analysis
Mechanical Design & Fabrication
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Stress Analysis
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Mathematical Analysis & Applied Statistics
Computer Programming & Applications
Nuclear Engineering
Electrochemistry, Chemical Analysis & Process Design
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ONE GOOD MECHANICAL ENGINEER

This opening offers a young engineer an unusual opportunity to acquire broad experience in product design and to become an Assistant Group Leader.

You'll understudy a Chief Designer. You'll help supervise draftsmen and designers on commercial products. You'll carry out design functions of your own.

Experience in electromechanical product engineering desirable, but good junior M. E.'s with other experience considered.

Good salary, fine New England living, all benefits — *the big future!* Send resume to: H. F. Clarke, Manager, Commercial Equipment Engineering Department, Raytheon Manufacturing Company, Waltham 54, Massachusetts.

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ELECTRO METALLURGICAL COMPANY

Division of Union Carbide Corporation
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Through these freedoms, Marquardt stands established as the leader in ramjets, "powerplant of the future."

Through these freedoms, Marquardt leads the way into advanced engineering projects.

These freedoms — pioneering and growth — are as individual as each professional engineer, as collective as the entire Marquardt team. Through them, Marquardt now offers new and unlimited opportunity for professional engineers in two of the West's most stimulating areas. At Ogden, Utah, in the heart of the Wasatch Mountain vacation area, Marquardt is now constructing a multi-million dollar production plant to produce supersonic powerplants for the Boeing Bomarc interceptor missile. And in Southern California's San Fernando Valley, Marquardt professional engineers are involved in a major expansion program for design, development, and test of new ramjet engines and turbojet and ramjet controls.

If you are a professional engineer interested in the freedom to pioneer — the freedom to grow — for yourself and your company, we invite you to investigate the opportunities at Marquardt Aircraft, today. Please contact Jim Dale, Professional Personnel, 16551 Saticoy Street, Van Nuys, Calif.

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Study phenomena associated with moving surfaces to develop bearings and seals to operate in high temperature, corrosive and nuclear environments.

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Develop materials and fabrication methods for nuclear components such as fuel elements and control rods.

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Clevite Research Center develops new principles and new products for other units of Clevite Corporation. The Research Center provides the ideal environment for the engineer because it has been supplied with the facilities, equipment and library to provide new knowledge and new products for Clevite Corporation, a company whose entire product line is in the growth fields of electronics, semiconductors, and automotive and aircraft power plants.

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MECHANICAL OR CHEMICAL ENGINEERS FOR DESIGN ENGINEERING AND CONSTRUCTION OF PETROLEUM RESEARCH PILOT PLANTS

Engineers are needed to act as project engineers in a growing company in the field of process research.

Work consists of translating process requirements into completed operating pilot plants and includes mechanical design, proper application of equipment, instrumentation, cost estimation, scheduling, materials procurement, field supervision of construction, initial operating shake-down, and new equipment development.

Experience in any of the above fields is desired with the ability to direct the work of others and to deal with a professional research staff. Excellent opportunities for advancement. Salary commensurate with training and experience.

Give full details of education, experience, desired salary, availability date and references. All inquiries will be considered promptly and held confidential.

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(Chief Technical Affiliate—Standard Oil Company (New Jersey)
Esso Research Center
Employee Relations—C
P. O. Box 51 **Linden, N. J.**

L. A. Riedinger (center) Design Specialist, J. E. Jean (left) Stress Group Engineer, and J. A. Johnson, head of the Structures Engineering Department, discuss structural effects of high thermal gradients in thin wall pressure vessels.

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The ever increasing performance requirements of guided missiles are paralleled by structures problems that grow constantly in complexity. Of these, transient thermal stress is one of the most urgent in light of projected new developments.

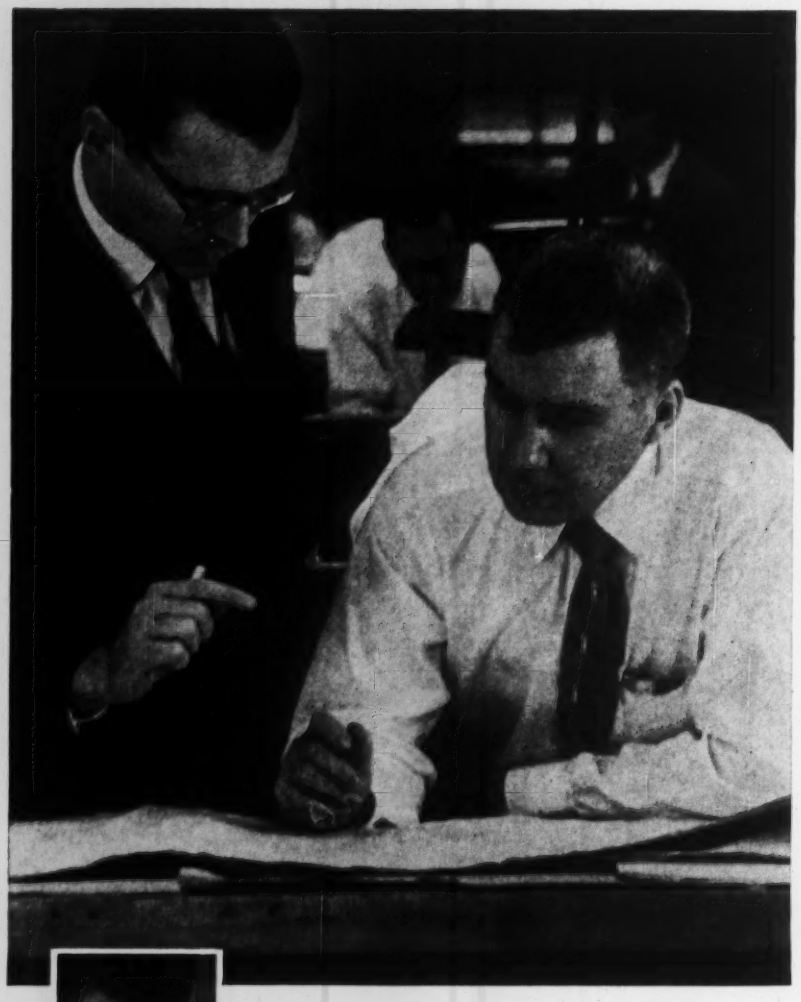
Several approaches offer solutions to this problem. Both new design concepts and advanced methods of analysis, utilizing the most modern computers, present favorable avenues of solving structures problems such as transient thermal stress.

Other areas of interest include:

- Thermal buckling and stress investigation.
- Structural optimization in time-temperature environment.
- Structural dynamics including acoustic vibration, flutter, vibration isolation and dynamics of elastic bodies.
- Evaluation of materials for high temperature strength and short time creep properties.

Positions are open on Lockheed's Sunnyvale, Palo Alto and Van Nuys Staffs. Those possessing a high order of ability and interest in these fields are invited to write. Please address the Research and Development Staff, Sunnyvale 24, California.

Lockheed **MISSILE SYSTEMS DIVISION**
LOCKHEED AIRCRAFT CORPORATION
SUNNYVALE • PALO ALTO • VAN NUYS • CALIFORNIA



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Write today to Mr. J. J. Rostosky, Speedway Laboratories, Linde Company, Division of Union Carbide Corporation, P. O. Box 8237, Indianapolis 24, Indiana.

Linde

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Westinghouse ELECTRIC CORP

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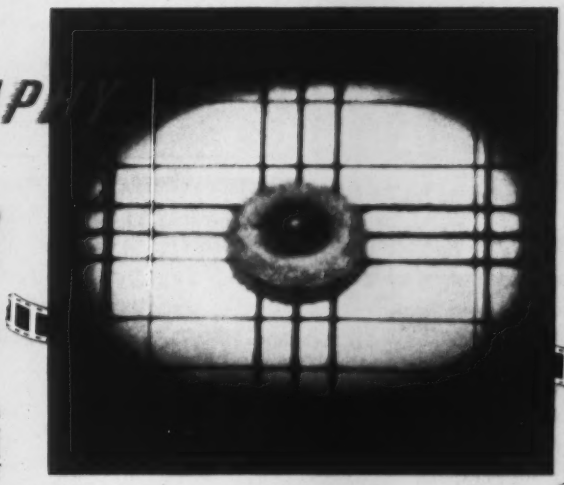

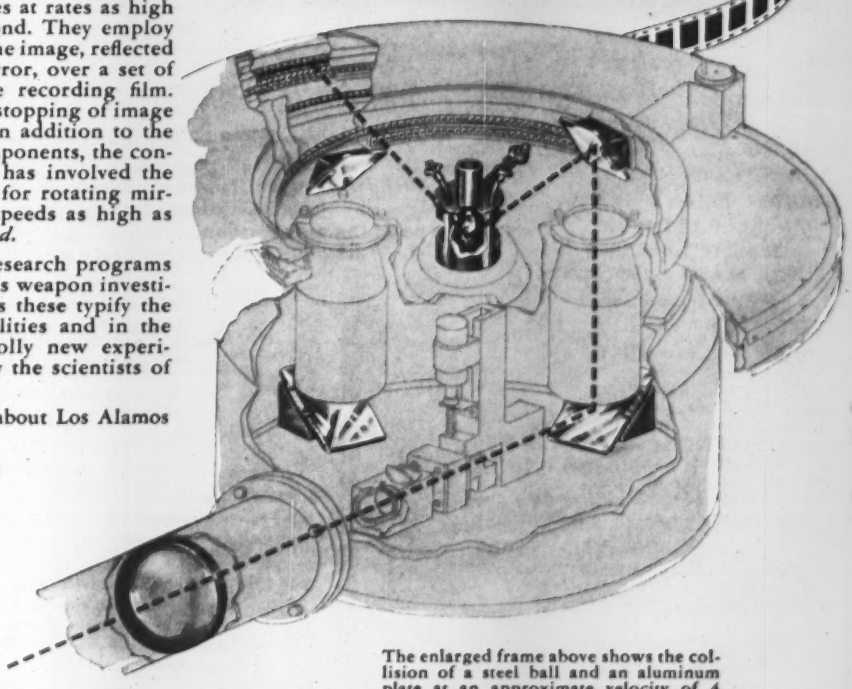

Here at Los Alamos, the development of high speed photography has produced framing cameras of unprecedented framing rates and exposure times. These cameras are capable of taking as many as 90 frames at rates as high as 15 *million* frames a second. They employ the technique of sweeping the image, reflected from a rapidly rotating mirror, over a set of correcting lenses onto the recording film. This results in the effective stopping of image motion within the frame. In addition to the creation of new optical components, the construction of these cameras has involved the development of techniques for rotating mirrors of substantial size at speeds as high as 22,000 revolutions *per second.*

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Director of Personnel
Division 1807

The enlarged frame above shows the collision of a steel ball and an aluminum plate at an approximate velocity of 4 millimeters/microsecond, illustrative of studies of interaction of metals at high impact velocity. The cutaway drawing shows some of the features of one of the Laboratory's high speed framing cameras.

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scientific laboratory
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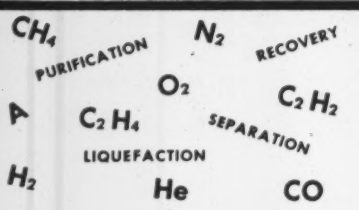

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The Company is the leader in the engineering, design, manufacture and construction of plants and systems for the separation of gases such as Oxygen, Nitrogen, Carbon Monoxide, Hydrogen and other low boiling building blocks of the chemical industry. We must expand the entire organization to meet the increasing demands of the steel, metallurgical and chemical industries, and for national defense.

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You wouldn't believe that a submarine hunt could develop into a profession, but it did. Nor that the "thinking" of a gambler would end up as a stalwart tool of this same profession, but it did. The profession is Operations Research.

In our organization we are taking these quaint items in stride as we use O. R. Cautiously at first, then more enthusiastically, we have found that the ideas really work. We have found that the use of electronic computers is helping us design plants much faster. In fact, we feel justified in hailing the use of the electronic brain as a major break-through in engineering work. We need the help of mathematicians and mathematically inclined chemical, mechanical and electrical engineers in this work.

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If you are interested in this kind of work, write us. We represent a large, integrated company in the oil industry. Here is opportunity on the ground floor in a new exciting and rapidly growing profession. Please address your letter to Box CA-6178, Care of MECHANICAL ENGINEERING.

ENGINEERS-SCIENTISTS: TEMPERATURES TWICE AS HOT AS SUN'S SURFACE NOW PRODUCED AT G.E.'S AEROSCIENCE LAB

New "Water Arc" Advances Nose Cone Technology at Missile & Ordnance Systems Department of General Electric

When MOSD became prime contractor for ICBM Nose Cone development, engineers and scientists here were faced with the necessity of creating not only new systems concepts, new components, new materials and new fabrication techniques, but also the *very tools and facilities to evaluate them.*

Meteors may melt on entering the earth's atmosphere, but the relatively thin-skinned nose cone must come through in full functional order. To test out heat-resistant materials capable of withstanding re-entry temperatures, a new instrument was devised under the direction of the research staff of MOSD.

...the WATER-STABILIZED ARC

How does the new water arc differ from the conventional electric arc? It is controlled–or stabilized–by a whirling blanket of water, which produces a "squeezing" effect, forcing the arc into the shape of a column. By causing a great amount of electrical current to flow across the column, extreme temperatures may be maintained continuously, subject only to the limitations of available power.

Valuable experiments are now being conducted at MOSD's Aeroscience Laboratory with the stabilized water arc. The most advanced heat-resistant materials are subjected to temperatures as high as 25,660°F–more than twice the heat of the sun's surface.

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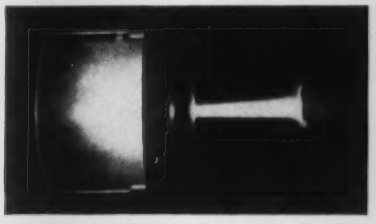
G.E. has built the largest, most powerful Shock Tunnel in the country in Philadelphia. Here free flight conditions in the order of Mach 20 can be matched. MOSD also utilizes a high power Centrifuge to test behavior of electromechanical and structural components under gravity loads up to 100 G's.

STABILIZED WATER ARC and G-E designed TUNNEL shown during operation. Material undergoing test is held in front of the arc orifice by means of a rod or "sting" running through the tunnel.

3000 KW used in operating this stabilized arc and evacuation tunnel. (Shown idle.) Has ¼" nozzle diameter. Present plans call for construction of a 3" diameter model, requiring 8,000 KW for operation.



View of fluid-stabilized arc in operation. The liquid revolving inside the glass or plastic cylinder flowing at high velocity offers insulation as well as the material of which the plastic beam is composed.

OPENINGS FOR MEN WHO CAN EXPLORE NEW TECHNICAL AREAS

Engineers and scientists find an ideal research environment at MOSD. They work in small groups on problems of prime scientific interest – in close contact with managers and top specialists.

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Organized only in '56, MOSD has been growing phenomenally, and continued expansion is scheduled for '57. This expansion creates many opportunities to rise to positions of higher responsibility and income level. All of the managers of technical groups are themselves engineers or scientists and the majority have come up from within this or other departments of General Electric.

YOUR INQUIRIES INVITED:

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...send us your resume or, if you prefer, write us for a convenient application form.

Your resume will be carefully reviewed by the MANAGERS of our various technical components. If qualified, you will be invited to visit our offices and discuss the work we are doing directly with the managers with whom you would be working. All communications will be entirely confidential.

Mr. John Watt, Professional Placement, Room 590-9

MISSILE & ORDNANCE SYSTEMS DEPARTMENT

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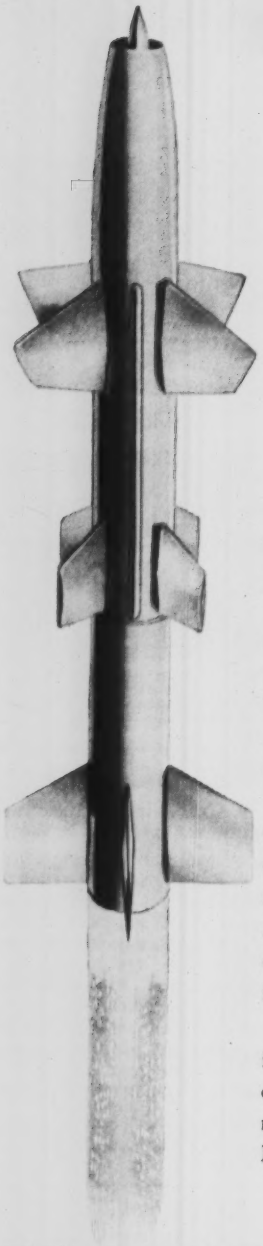

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If you want to enjoy the advantages available in the rapidly growing guided missile industry, you can make no better start than by completing and returning to us the coupon for the booklet "Your Future in Guided Missiles".

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Gentlemen: I would like more information concerning opportunities in guided missiles. Please send me the booklet "Your Future In Guided Missiles."

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CITY _____ STATE _____

SEE CHEMSTRAND'S AD ON PAGE 65 OF THIS MAGAZINE

Positions available for

ENGINEERS

(Chemical, Mechanical, Metallurgical, Textile, Industrial, Instrument and Civil) and

CHEMISTS

(Organic, Physical, Analytical—Instrumental and Wet Method, Textile Chemists.)

Write to Technical Personnel Department

THE CHEMSTRAND CORPORATION

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B.S.—Ch.E. or M.E. Five to ten years' experience in process industries, preferably food or chemical, for plant engineering division. Design and installation of new facilities. Salary commensurate with experience. Submit detailed resume.

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Administrative responsibilities in the flow and pressure instrument field. We are seeking a man with at least 10 years' engineering experience to direct the engineering activities and new instrument development work of our Instrument Division.

Degree in mechanical or electrical engineering necessary; must have working knowledge of electronics and preferably some administrative experience. Age preference 35-45.

Good salary plus profit sharing and other benefits.

Write to J. B. Meriam, Jr., President, giving full resume.

The Meriam Instrument Company
10920 Madison Avenue
Cleveland, Ohio

For Consulting Engineers Turn to Page 182

INSTRUMENT ENGINEERS

Two rapidly expanding research and development divisions each require an experienced instrument or electronics engineer. Challenging opportunities to develop and apply techniques in instrumentation and automation. Candidates considered with degrees in electrical, mechanical, or chemical engineering.

Instrumentation of Pilot Plants

An instrument engineer needed to act as project engineer and consultant to other engineers in the field of pilot plant design.

Typical equipment includes analytical instruments, data loggers, programmers, controllers, recorders and indicators of many types.

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Address replies to:

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(Chief Technical Affiliate—Standard Oil Company (New Jersey))
Esso Research Center
Employee Relations-C
P.O. Box 51 Linden, N. J.

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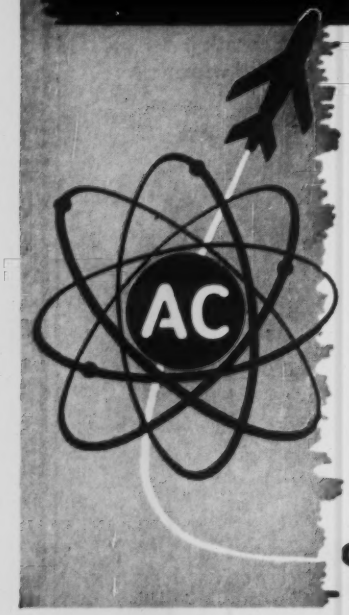

GM CAREER OPPORTUNITIES IN

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Development Engineering
Project Coordination
Design Engineering
Product Engineering
Product Evaluation
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Supervisor of Technical Employment

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THE ELECTRONICS DIVISION

GENERAL MOTORS CORPORATION

Flint 2, Michigan — **Milwaukee 2, Wisconsin**

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A position with supervisory responsibility is available to an engineer or physicist to head a group conducting advanced work in the cooling of electronic equipment. This group of engineers and laboratory assistants provides consulting services to a development laboratory of 500 engineers.

The work involves use of heat transfer and fluid flow principles in the development of cooled chassis, evaporative-gravity and contact cooling techniques. The analysis work is substantiated in a well equipped laboratory designed expressly for this purpose.

Challenging cooling problems are developing daily in our expanding electronic work.

Reply with brief statement of background to: Donald B. Stillman.

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Excellence in Electronics

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WAYLAND LABORATORY
WAYLAND
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MECHANICAL ENGINEERING
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Personnel Manager
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McGRAW-EDISON COMPANY
Zanesville, Ohio

"OPPORTUNITIES" Section This Month 160-180

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Recent Engineering graduates, preferably M.E., for approximately one year inside sales training prior to assignment to a territory. Send complete resume to Personnel Department.

EDWARD VALVES, INC.
Subsidiary of Rockwell Manufacturing Company
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Send resume of education and experience with statement of salary requirements.

Address CA-5905, % "Mechanical Engineering."

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The new Fibers Division of the American Cyanamid Company is soon to manufacture, on a large scale, an acrylic fiber called Creslan®. Ground will be broken shortly for a plant at Pensacola, Florida, which will have an initial production of 27,000,000 pounds per year of staple and tow. Understandably, the Division itself, and its Research Facilities at Stamford, Connecticut, are expected to grow substantially in the future. Here, then, are ample opportunities for able and experienced men anxious to accept new challenges.

MACHINE DESIGN ENGINEERS

Excellent opportunities with the Fibers Division and the Research Division for men with 3-10 years' experience. Prefer engineers well-versed in Textile Machinery.

Direct Inquiries to:

D. W. CLARK, AMERICAN CYANAMID COMPANY
1937 W. Main Street, Stamford, Connecticut

CYANAMID

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Ethyl Corporation is seeking mechanical engineers with BS degree for project engineering and inspection work. While applicants with from 2 to 5 years' experience are preferable, the experience is not absolutely essential.

These positions are located at Ethyl's Houston plant. They offer salaries commensurate with training and experience plus outstanding benefit plans. Opportunities for growth into supervisory and management positions are excellent.

Interested persons are invited to submit a complete resume of their training and experience to:

Mr. R. S. Asbury
Ethyl Corporation
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- *Special Machinery for Paper Laminating & Corrugating*

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HENRY PRATT COMPANY • 2222 South Halsted St. • Chicago 8, Ill. Attn. Mr. R. P. Saar Dept. ME-C

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Ideal candidate would be Engineer, with Bachelor's Degree or better, having fundamental knowledge of combustion principles and practical experience in design and operation of oil burning equipment. Send Resume to:

SOCONY MOBIL OIL COMPANY, INC.
TECHNICAL SERVICE LABORATORY
412 Greenpoint Avenue
Brooklyn 22, New York

It will pay you to watch the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

POSITIONS OPEN

Continued from Page 179

MECHANICAL ENGINEERS

Research and Development

Interesting positions open for mechanical engineers on a wide variety of projects in the following fields:

Machine Design
Servomechanisms
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B.S. to Ph.D. in mechanical engineering with 3 to 5 years' experience in one of these fields essential. These are permanent positions offering an opportunity to use your initiative and creative ability. We offer excellent employee benefits including tuition free graduate study. For employment application, please write

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APPLY: DeLaval Steam Turbine Company
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MECHANICAL ENGINEER—Research Laboratory located in eastern Pennsylvania college town has an opening on its staff for a graduate mechanical engineer. Laboratory is searching for ways to improve newspaper production methods. Applicant should have some experience in general engineering work. Moving allowance will be made. First letter should include photograph, personal data, resume of experience and salary desired. Address CA-6215, care of "Mechanical Engineering."

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REFRIGERATION ENGINEER—Assistant to chief development engineer handling design, prototype development and testing of refrigeration and air conditioning equipment. Prefer graduate engineer under 40 with design experience in refrigeration and air conditioning. Middle Atlantic States location. Excellent opportunity. Salary range $7500 to $8500. Send resume including experience, recent earnings and education. Box 150 Realservice Advtg., 110 West 34th St., New York.

BUSINESS OPPORTUNITIES

Louis Newmark Ltd., a well known British firm of precision Engineers and instrument makers (London Area) are desirous of entering into a License agreement, or purchasing outright, patents relating to electrical and/or mechanical devices of a Precision Instrument character or of a consumer goods nature.

Adequate capital and production facilities are available to develop, produce, and market suitable devices. Communications should be addressed to

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and marked for the attention of
Major S. F. N. Neill.

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WANTED—Manufacturer of engineered products who requires competent technical and sales representation; can provide well documented engineering experience and aggressive Sales Engineering concept; will cover West Coast Aircraft and Industrials according to your needs. A. H. Fink, Engineer; Suite 206, 9489 Dayton Way, Beverly Hills, California.

POSITIONS WANTED

MECHANICAL ENGINEER—26, BSME, ASME Member, 3 years' engineering experience, desires to act as agent, representative, or liaison in Europe for American firm. Address CA-6204 care of "Mechanical Engineering."

ENGINEERING SUPERVISOR—38—B.S. Eng. Sci. & Appl. Phys., Married. 8 yrs.' experience in Chemical and Rayon plant maintenance, equipment layout and development, cost reduction, craft supervision. Seeks opportunity in N.E. New England. Address CA-6211, care of "Mechanical Engineering."

GRADUATE MECHANICAL ENGINEER—licensed to practice in New York, Tennessee, 2½ years' experience in design and testing of pressurized water reactor plants; 10 years overall experience in design, construction and testing of industrial plant services and power plant facilities, seeks position preferably east coast consultant or power group engaged in Nuclear Power field. Address CA-6212, care of "Mechanical Engineering."

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MECHANICAL ENGINEER—B.S. in M.E.—18 years' experience in refrigeration, air conditioning, ventilation and internal combustion engines. Experience includes heavy construction machinery, chemical and oil industries as engineer and consultant. Registered Professional Engineer in Michigan. Age 39, good health. Desire responsible position in industry or consulting fields. Address CA-6228, care of "Mechanical Engineering."

MECHANICAL ENGINEER—BSME 1949, Registered in Ohio, 5 years in jet engine controls engineering, including 1½ years' staff work, 1 year test engineering supervision, 1½ years' plant engineering plus practical working experience as machinist and mechanic, desires growth position with supervision, in small or medium-sized organization. Address CA-6219, care of "Mechanical Engineering."

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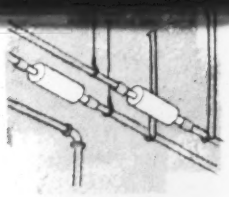

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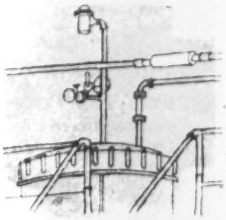

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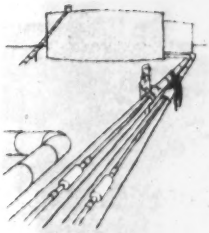

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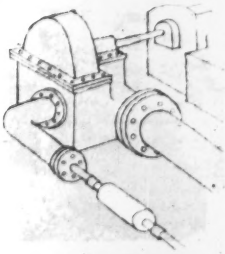

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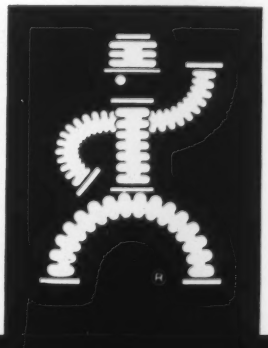

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Bell Laboratories researchers Henry S. McDonald, Dr. Eng. from Johns Hopkins, and Max V. Mathews, Sc.D. from M.I.T., examine magnetic tape used in new research technique. Voice waves are converted into sequences of numbers by periodic sampling of amplitudes, 8000 samples per second. General purpose electronic computers act on these numbers as a proposed transmitting device might.

They send real voices on imaginary journeys

In their quest for better telephone service, Bell Laboratories researchers must explore many new devices proposed for the transmission of speech signals. For example, apparatus can be made to transmit speech in the form of pulses. But researchers must always answer the crucial question: how would a voice sent through a proposed device sound to the listener?

In the past it often has been necessary to construct costly apparatus to find out. Now the researchers have devised a way to make a high-speed electronic computer perfectly imitate the behavior of the device, no matter how complicated it may be. The answer is obtained without building any apparatus at all.

The researchers set up a "program" to be followed by the computer. Actual voice waves are converted into a sequence of numbers by sampling the waves 8000 times per second. Numbers and program are then fed into the computer which performs the calculations and "writes out" a new sequence of numbers. This new sequence is converted back into real speech. Listeners hear exactly how well the non-existent device could transmit a real voice.

With this novel technique, new transmission ideas are screened in only a fraction of the time formerly required. Thus valuable time and scientific manpower are saved in Bell Laboratories' constant search to provide still better service for telephone customers.

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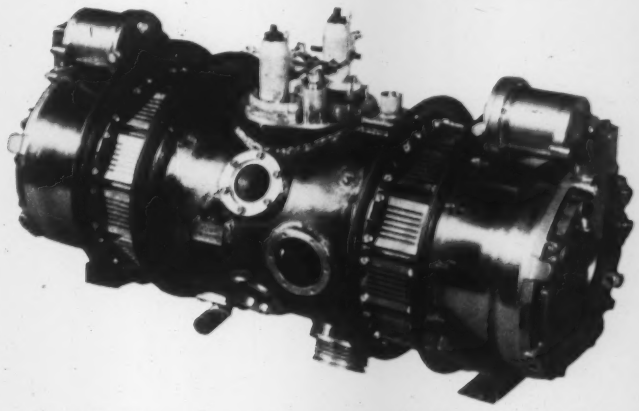

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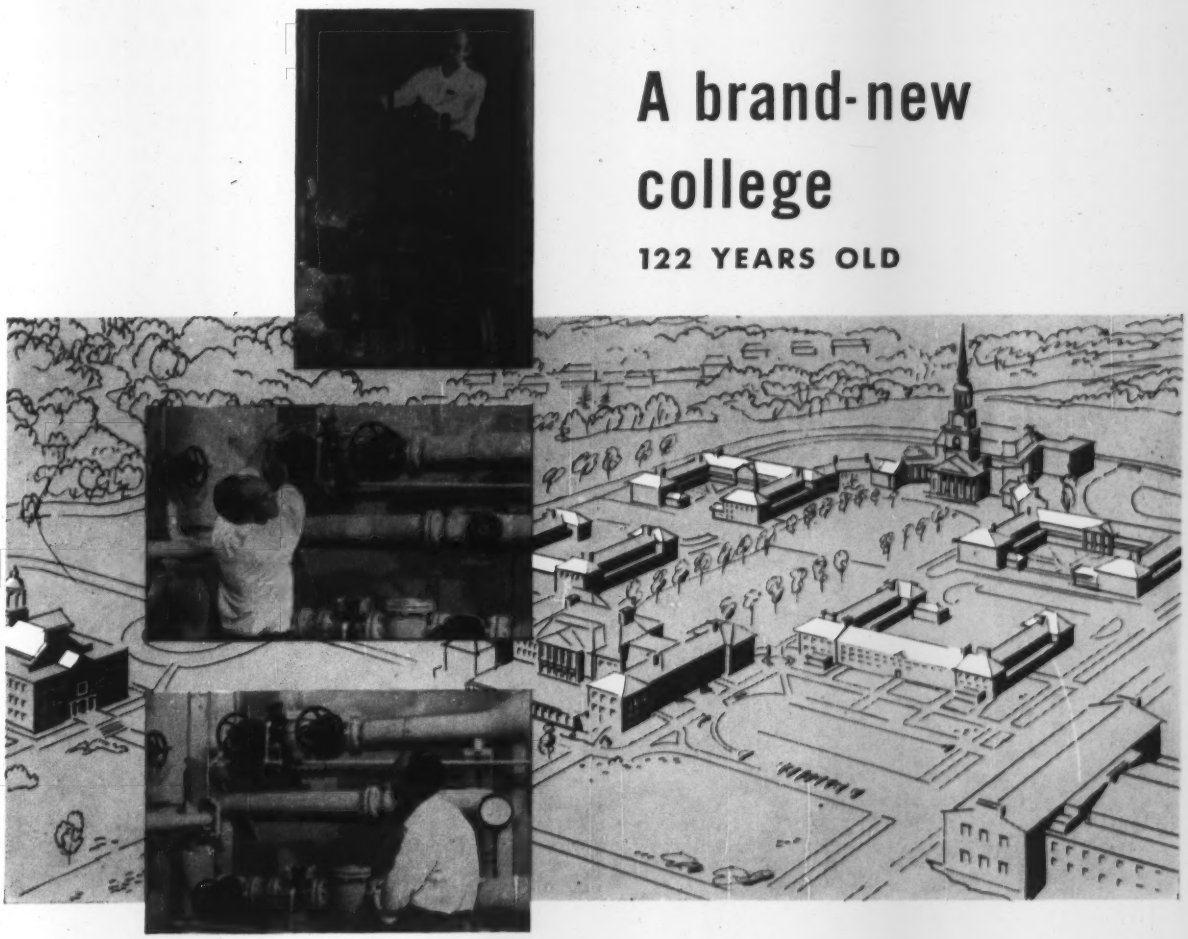

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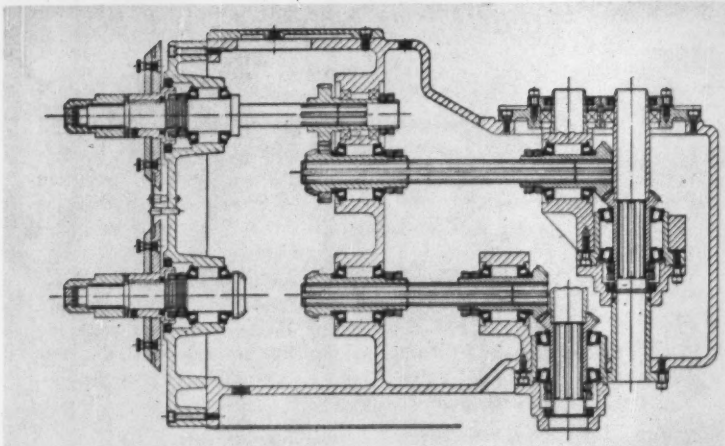
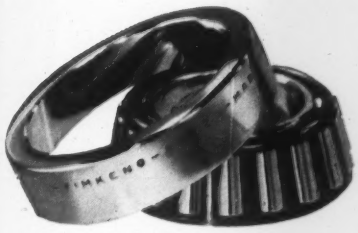
Maintenance costs are low, with Timken bearings built to last the life of the lathe. Friction is practically eliminated, conserving power. Timken bearings are geometrically designed, precision-manufactured, to give *true rolling motion.* To insure highest quality, we even make our own fine alloy steel—which no other American bearing maker does.

Look for the trade-mark "Timken" on each bearing! The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".



How **THE BULLARD COMPANY** mounts 16 Timken tapered roller bearings in the Hand Wheel Brackets of their vertical turret lathes.

This symbol on a product means its bearings are the best.



TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

TRADE-MARK REG. U. S. PAT. OFF.